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CLINICAL LECTURES

ON

DISEASES OF THE EYE

EXPRESSLY ARRANGED AND PREPARED FOR THE
PRACTITIONER OF MEDICINE AND SURGERY

BY

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PREFACE.

The following chapters have been arranged from my clinical lectures and conversations with students. They were then intended, as they are now, for the general practitioner and those who are beginning the study of ophthalmology. With this in view the discussion of necessary technical subjects has been brief and freed from unnecessary detail; methods not generally accepted have been avoided and the subjects covered have been the more common injuries, diseases and errors of the eye and their relation to general conditions rather than a review of the entire field of ophthalmology—the purpose being an exposition of my point of view and practice to-day. Fully appreciating the many short-comings of this volume it is offered for your friendly consideration without apology.

J. E. C.

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CHAPTER I.

LACHRYMAL DISEASES.

Acute dacryocystitis is at certain seasons of frequent occurrence. The ophthalmologist, however, seldom sees such cases till late in the acute condition, or until they have passed into the sub-acute or chronic stage. The history of an inflammation of the sac will be determined in a large degree by the treatment which it receives during the first day of its existence. To abort the condition in the acute stage, the treatment must be timely and thorough.

Without entering into the subject of ætiology or pathology, it is my desire to call attention to the treatment of the acute stage of these conditions, and to the procedure of ablation in the treatment of obstinate chronic cases, with a history of recurrence, or continued inflammation and suppuration.

Treatment of acute lachrymal cystitis in the early stages is directed toward the limitation of the inflammation and the arrest of infection both from within and without. Reduction of inflammation is effected by the use of cold compresses applied directly to the cutaneous surface (this can be done by using a finger shield filled with ice scrapings applied directly over the sac). The compress can be held in position by a rubber tape, passed below the ear on one side, and over the head and above the other ear.

After the swelling has been reduced sufficiently to allow the introduction of a probe or dilator, the canal can be dilated, and a small lachrymal syringe introduced and used as an aspi-

rator, the contents withdrawn, the syringe cleaned, filled with an antiseptic solution, re-introduced, and the sac thoroughly sterilized. This can be done under an anæsthetic if the patient will not allow manipulation without. I have found that after the ice bag has been used for two hours the patient will allow considerable handling, even in acute inflammation. In two cases I used the freezing ethyl with good results, protecting the lids with wool and a celluloid shield. The cleansing solution contains sodium bicarb., twenty grains to the ounce of water. The sterilizing solutions have been: Formaline (from 1:500 to 1:200), which I have discontinued on account of the great pain which it caused; argentum nitrate, which, in sufficient strength, also causes pain; and in the later cases, protargol (10 per cent.), with the best of results. The protargol was used once in each of four cases, and twice in one case.

The pain attending the introduction of the syringe, and the aspiration of the sac, requires that the patient have some fortitude, otherwise an anæsthetic must be given. With children general anæsthesia is almost imperative; for, to be effective, the treatment must be thorough and careful.

The subsequent treatment should consist of washing the sac with a hot solution of boric acid once daily; also directing the patient to flush the conjunctiva with the boric acid solution three or four times a day. If there is a persistent stenosis of the nasal duct, after both nose and sac have been carefully cleaned, and any tumefactions which may occur have been reduced, the use of the probe, through the dilated or slightly sectioned punctum, may be of service.

The method of slitting the punctum which I prefer is to introduce a Bowman lachrymal knife into the canaliculus (the cutting edge toward the eye) (Fig. 1) and make a slight cut into the conjunctival margin of the lid. This will allow the introduction of a probe of small size or a syringe. Too much stress cannot be laid, however, on the importance of maintaining the integrity of the excretory ducts, for once a knife

has been used the ducts lose their positive function, and drainage is purely capillary.

The treatment of the *dilated sac in sub-acute and chronic cystitis* is of importance. The custom of directing the patient to press the sac and empty it into the conjunctiva is not without its dangers, as a rupture of the sac wall may occur, and the contents be forced into the cellular tissue of the orbit, causing infection of the orbital cavity; or the wall may dilate at some point and gradually extend, forming an extensive hernia. In one case the hernia formed below the globe; extending

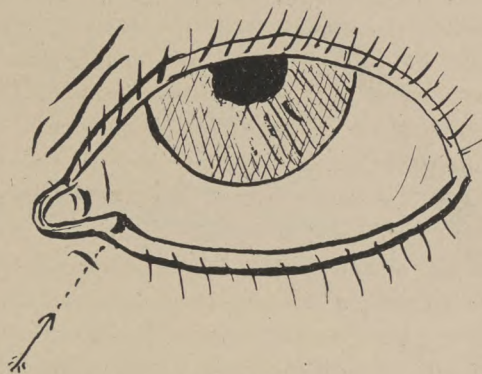


FIG. 1.
Showing direction of cut of punctum.

downward and laterally, it was $1\frac{3}{4}$ inch long, connected to the parent sac by a small tube the diameter of which was about that of a No. 2 Bowman probe.

The use of the probe should be limited to such cases as are manifestly due to organic strictures; and then slow and gradual dilation should be resorted to, taking care not to wound the mucous membrane. Where it is necessary to cut through the folds of fibrinous or cicatricial strictures, in order to re-establish the patency of the duct, a broad canthus-knife can be used, followed by Bowman probes (from No. 8 to No. 12), and a gelatin bougie, introduced and allowed to dissolve, it being held in place by a compress bandage. The

second introduction of the probe and bougie should not occur later than the third day. They should be introduced again on the fifth day and every three days until the stricture is fully dilated and healed. After the fifth day the sac and canal can be washed with a 5 per cent. protargol solution. The duct should not be flushed with peroxide just after the use of the probe or knife, lest the solution penetrate the cellular tissue and carry with it active septic matter. I have seen acute cellulitis follow the introduction of peroxide of hydrogen into a recently probed passage.

The *absence of the punctum*, either as the result of disease or lack of development, is of occasional occurrence. The

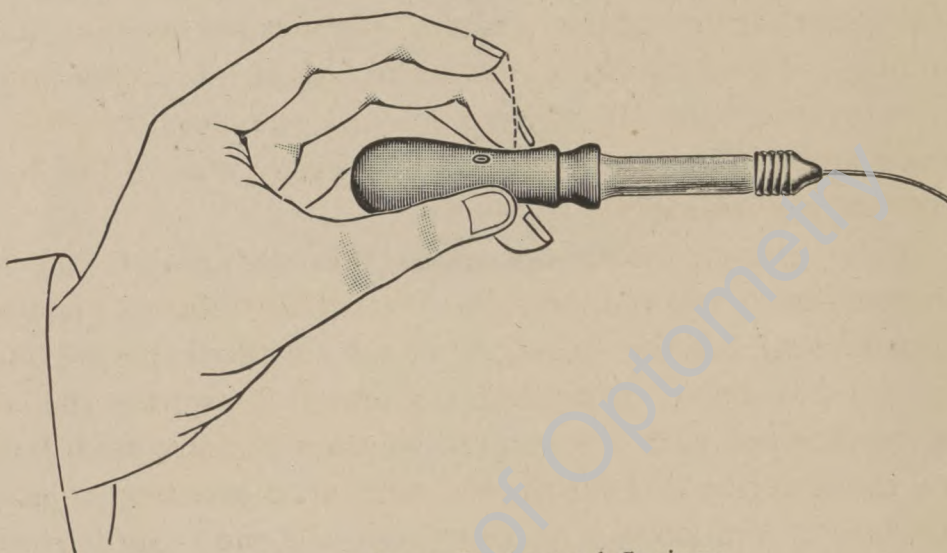


FIG. 2.—Dunn Lachrymal Syringe.

canals can be opened either by a knife or scissors; the edges of the wound cauterized with silver nitrate (4 per cent.) and probes passed till the new punctum has healed open.

The treatment of the *lachrymal sac in the aged* is attended with many inconveniences and disappointments. The laxness of the tissues and tendency to ectropion render the cure of epiphora uncertain.

The use of the larger probes has been without avail unless the patient could acquire the knack of introducing them himself; for they are only of use as long as they can be introduced

frequently (once daily). In order to use a large probe, the canal must be opened (the sphincter of the sac severed) and kept open till healed. A small probe can be used by simply dilating the punctum to allow its entrance. This probe is of no benefit except for sounding the lachrymal duct; and its introduction should not be insisted upon if it meets with resistance, lest a false passage be made and infection carried to deeper parts. Solutions should not be injected into the lachrymal canals soon after the passage of the probe or sound, or after the slitting of the canal, lest an infiltration of the tissues follow.

In the case now before us we have a firm, tender swelling at the inner canthus of the right eye, of about twenty-four hours standing. The patient had an acute attack of coryza and is just recovering from it. There is some pain and a feeling of tension and aching extending over the right side of the face. Epiphora is a noticeable symptom.

Firm pressure does not expel the contents of the sac. The punctum is red and swollen. We will introduce a punctum dilator and stretch the passage enough to allow the entrance (Fig. 2.) of a Dunn lachrymal syringe, and aspirate the sac, then wash it out with a saturated solution of boric acid, withdraw this solution and fill the sac with a 10 per cent. solution of protargol, and allow it to remain in the sac. An ice compress will now be applied over the inflamed sac, taking care that the cold does not reach the lids covering the cornea.

From my experience I should judge that three treatments would be sufficient to clear the sac and duct of inflammation and render it possible to deliver the solution by way of the sac and duct into the nose. The home treatment, aside from the cold compress, will be the 2 per cent. solution of sodium biborate, dropped into the eye every two or four hours. The point I wish to make in this line of treatment is that the integrity of the lachrymal apparatus has been maintained, and that the function is positive and chronic epiphora will not result.

The *destruction of the lachrymal sac*, in chronic inflammation, has been for many years an occasional procedure for the removal of a dangerous source of infection to the cornea, as well as of a disfiguring and irritating local condition.

The interruption of the normal drainage of the eye is one of the early results of disease of the excretory apparatus and epiphora results, even though the canal may be open to the passage of a probe, and the injection of antiseptic and stimulating liquids. The epiphora in itself, while annoying, is not dangerous to the cornea or conjunctiva, and is seldom irritating except in an otherwise diseased condition of the conjunctival surface. In a case of epiphora, however, in which the lachrymal sac is secreting a large amount of septic muco-pus, which is constantly pressed into the conjunctival sac, we have a source of irritation and danger which demands our attention. These secretions and discharges are of the most virulent type, and but for the protecting power of the normal tears, jeopardize the integrity of the cornea.

Let the mucous membrane and lachrymal secretions become abnormal, and the integrity of the cornea impaired, and we have a situation fraught with greatest danger to the eye. For this reason a surgeon will not operate for the removal of a cataract, or for the relief of any intraocular condition, without first curing, if possible, the lachrymal disease, or removing the sac *in toto*.

The causes which lead up to a chronic suppurative dacryocystitis are not numerous, being, in order of frequency, acute nasal catarrh, chronic nasal catarrh, acute conjunctivitis, chronic conjunctivitis and specific rhinitis, the passage into the sac of foreign bodies and the formation of concretions about them. Syphilis, either acquired or hereditary, may be the cause, and may invade the sac from either the nasal or conjunctival mucous membrane, or be of purely local origin. It is rarely the case that the diseased condition occurs primarily in the sac.

The cases in which the operation of extirpation is considered are those where all accredited means of cure have been tried and there is still a constant or recurring muco-purulent inflammation of the sac. The dangers referred to are: to the cornea by the infection of a slight corneal abrasion; the production of a low form of conjunctivitis from the reflow of tears and secretion into the conjunctival sac; the maceration of the cornea, and resultant ulceration.

Many of our cases come from distant and often rural localities where they cannot give the time necessary to securing the skill of their family physician, or there may be no one at hand familiar with the simple technic of probing and washing.

The following cases will illustrate the indications as they have appealed to me for a radical operation:

Miss L. L., domestic, aged twenty-five; for five years has had a recurrent inflammation of the lachrymal sac, with continuous discharge of pus and mucus. She has been under the care of some of our best clinicians, has been well and thoroughly treated, but four or five times a year an acute inflammation would be followed by subacute and chronic muco-purulent discharge. Thorough treatment would soon reduce the quantity of discharge and the tumefaction, but the purulent character was only modified. An attempt has been made to destroy the sac with some caustic, but it was not successful, leaving an ugly scar just below the location of the sac. My advice, after watching the patient for some time, was to have the sac either destroyed by cautery or removed with the knife. My grounds for this advice were both hygienic and economic.

The epiphora would not be greater in quantity after the operation and probably not as great as prior to it, for the conjunctivitis could be cured and the irritation from that source reduced, lessening the lachrymal secretion. The loss of time and inconvenience, and the suffering both from the disease and

the means used for its relief, were also important factors in influencing the patient to take my advice.

The sac was removed, together with the disfiguring scar. The canals were closed and an antiseptic dressing applied. The wound healed by first intention. Three months after the operation the scar was hardly noticeable, epiphora slight, and, under favorable conditions, evaporation was sufficient to keep the eye dry. Two years later the fellow eye, which had been giving more or less trouble for years, but until lately had been tolerable, began to have recurrent attacks of cystitis. At the patient's request I extirpated the sac, and but slight epiphora results.

Mary K., aged eighteen, had acute dachryocystitis following a purulent ophthalmia, recurring attacks; was better under treatment but relapsed as soon as it was discontinued. Cornea at times hazy, the conjunctiva rough, and at times secreting muco-pus. The danger to the cornea, and the previous history, led me to advise the ablation of the sac and closure of the lachrymal duct. The result of the operation was favorable, and after several months there was no epiphora under ordinary conditions.

Operation:

1st. Ligature the canaliculæ near the sac.

2nd. Make an incision 8 to 10 m.m. in length directly over; dissect down to the sac and separate its side walls from the surrounding tissues. Introduce the retractor and dilate the wound (the use of this instrument greatly reduces the bleeding).

3rd. With the blunt gouge detach the sac from its fossa; with the forceps retract and sever it from the mucous tube leading into the duct. During the operation the wound should be flooded with a hot boric acid solution to prevent its infection in case the sac is ruptured. The wound can then be sutured and closed.

The difficulties and complications of the operation are

not numerous; first, infection of the wound from the conjunctival sac, which can be prevented by carefully ligaturing the canals; second, where there is nasal suppuration and necrosis of the lachrymal canal, it is necessary to curette the canal, remove all the dead bone within reach, and instead of closing the wound and sealing with collodion put drainage into the lower angle, using silk floss or cotton wicking and allowing the wound to heal by granulation.

In uncomplicated cases the sac is cleaned with 1 to 1000 formalin solution, the conjunctiva washed and cleaned with 1 to 5000 bichloride of mercury solution, the canals ligatured and the sac removed through a free opening, the wound closed by fine sutures and sealed with collodion. I usually lay a wafer-like pledget of cotton over the wound and apply the collodion dressing. Four or five days later the wound is dressed, and if there has been no infection and the operation clean, the pledget can be left off, the stitches removed and only a thin film of collodion applied. Two out of my twenty cases had suppuration following the operation, and in one of the two cases I had to re-open, curette, ligature the canal and put in a drain.

The cases in which the punctum had been enlarged only sufficient to allow the use of the probe and syringe are much more simply managed than where the canaliculus has been split to the sac, for the sac wound can be preserved from infection by the conjunctival secretions in the uncut cases.

Among the causes for recurrent inflammation of the sac may be mentioned the hernial extension of the sac, the result of over-tension from stenosis of the ducts and pressure used to empty the sac into the nose or conjunctiva, as we often direct these patients to do to relieve the distention and prevent the decomposition of retained secretions.

In operating I prefer the knife to the caustic or cautery as the scar from the knife is finally obliterated. In old cases where there has been severe inflammation, infiltration, fistula and superficial destruction of the tissue, the resultant

contraction may tend to keep the sac distended, as is the case after emptying the tumefied sac by pressure and then pressing again, the result would be expulsion of air bubbles, which had been drawn into the sac by the action of the cicatricial tissues which would not allow it to collapse. In these cases plastic measures are needed to secure a good cosmetic result.

The instruments required are a retractor (Fig. 3) a small scalpel, small dissecting forceps, two fixation forceps, a flat, dull gouge for working about the sac to separate it from the fossa, two bone curettes (one quite small for cleaning out the duct and a larger and stronger one for removing diseased bone in the region of the sac), needle-holder, needles, colloidion, drainage silk or cotton wicking.

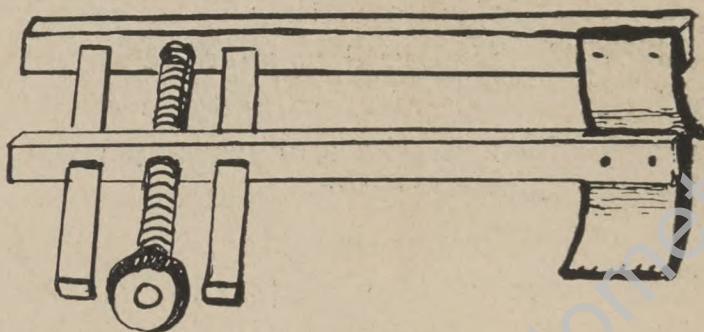


FIG. 3.
The Author's Retractor.

The closure of the canaliculus I believe to be an important step in the operation and should be done before the incision for the removal of the sac has been made. The after-treatment of the conjunctiva must follow the general indications. My objections to the use of a cautery and caustics for the destruction of the sac are, first, the pain and reaction more or less continued; second, the difficulty of limiting the area destroyed; third, the resulting scar.

The main objection to the removal of the sac is the chronic epiphora. In my cases the removal of the irritating sac has been followed by a decrease in the flow from the lachrymal glands and mucous surface of the conjunctiva. In a short time the epiphora is absent except on exposure to wind,

dust, or irritating vapors, or in mental emotion; and is hardly more annoying than in the normal eye. Dryness of the nose is sometimes annoying, and the use of vaseline to prevent



FIG. 4.

Showing position of incision and retractor in position.

sneezing has been resorted to; but this is hardly more troublesome than, or as dangerous as, the septic condition of that mucous membrane from the lachrymal disease. (Fig. 4.)

The case we have for operation is: Mrs. L., fifty-four

years of age. Fifteen years ago she had a suppurative dachryocystitis, with frequent relapses and more or less discharge of muco-pus from the sac. She had been instructed to empty the sac by pressure. The duct had been frequently treated with benefit, but always followed by relapse. About four years ago first noticed a small tumor in the orbit, just below and to the nasal side of the eye. It was tender at all times but never markedly inflamed. About one year ago first noticed unusual increase in size and increase in tension. Unable to move the eyeball freely in any direction, the eye displaced up and out. There is double vision, the conjunctiva is injected and the eye is sensitive to light.

The sensation to touch is that of a small marble somewhat deeply seated in the orbit. I cannot determine any connection between the lachrymal sac and the tumor. The lachrymal sac is now freely opened, and from its most dependent point a small, tube-like body extends back into the orbit, its lumen being obliterated. The diameter of the tube is about 1 m m. It is marked by two dilations from about $1\frac{1}{2}$ to 2 m m. in diameter, and is connected to a large oviform mass quite regular in form, 15 m m. in length by 10 m m. in diameter. The upper wall is adherent to the eyeball, the lower to the periosteum of the orbit. The walls of the tumor are quite dense, and of simple connective tissue. The inner layer of the wall has all the characteristics of pyogenic membrane. The contents seem to be made up of disintegrated blood and serum. At the most dependent portion of the tumor is found a small mass containing softened cilia, grit and what seems to be a small rusted bit of iron.

We have to deal with a chronic dachryocystitis with a hernial sac extending back into the orbit.

In our operation we have tied off the canaliculi; removed with knife, curette and gouge all remaining portions of the tumor walls; burred out the lachrymal duct and thoroughly cleansed the wound. We will now close it with sutures and seal it with a collodion dressing. We must depend upon the

cleanliness of our operation to secure for us a closure of the wound by first intention.

Acute suppurative inflammation of the lachrymal sac which runs a rapid course may occur in cases subject to blenorrhœa of the sac or as the result of an acute infection from the nose or conjunctiva. Cases of this class were quite numerous during the first epidemic of *la grippe*. (Plate I.)

The case which I now present, Mr. T., aged thirty-two years, a book-keeper, was seized two days ago with a severe pain in the region of the sac, slight tenderness with epiphora and general œdema of both sides extending to the outer canthus of the left eye. He now presents himself with the eye swollen closed, the lids inverted till the lashes sweep the cornea. He has a temperature of $101\frac{1}{10}^{\circ}$. At the inner canthus there is a hard tumor, slightly fluctuating to the touch and very painful. The pain has increased during the last twelve hours. Hot fomentations have been used and one of the coal-tar preparations given to reduce the temperature and relieve the pain. In this case at this stage of the disease we must make a free incision into the sac from the cutaneous surface. We will now clean it out with a hot solution of boric acid, and pack it with iodoform wicking, which I prefer to the gauze as it does not leave fragments behind that may find lodgement in the sac. It must be dressed again in four hours, cleaning with boric-acid solution and again packing with the iodoform dressing.

(Three days later.) The swelling has left the lids, the discharge from the sac is not purulent and with the lachrymal syringe I am able to wash the nasal duct, and can pass a small probe from the punctum to the sac.

The cutaneous wound can be closed with a deep suture and pressure applied over the sac. The eye should now be drenched with a sterile solution of soda biborate every two hours and remain uncovered. The external wound should be

allowed to heal as promptly as possible to prevent the formation of a fistula.

This patient, Mr. H., aged forty, has a chronic epiphora the result of an early, neglected dacryocystitis. He has been under treatment at various times for many years, receiving little benefit and no permanent relief. Cases of this class give us the least returns for our efforts of any coming for our care, partially from the difficulties which have to be overcome, but more especially from the inability or unwillingness of the patient to continue under treatment, and suffer the pain and expense.



FIG. 5.

1. Dotted line showing the place in which the cut should be.
2. Solid line, the cut in this case.



FIG. 6.

In this case you will notice that the canal has been slit from the punctum to the sac; the opening is free for the entrance of a large probe, No. 10 Bowman, yet the tears do not flow into the nose. The trouble is due in part to the position of the cut. It is too near the cutaneous border of the lid and remains closed because of the pressure of the lid against the eyeball and somewhat fleshy caruncle. (Fig. 5.) I shall try to remedy this by removing the mucous lip of the canal, from the punctum to the mouth of the sac, and shall introduce a solid tin stylet into the duct to prevent the contraction of the entrance of the sac. The instrument I prefer is made of pure tin and is curved at the end to prevent its slipping out of position. (Figs. 6 and 7.)

There are some benefits obtained by the use of the stylet for a short period, two or three weeks at a time. As soon as the cut is closed I shall try to teach this patient to use both probe and syringe. Then he can take care of his eye without our aid.

To operate upon the lachrymal punctum, canaliculus, and duct, you should stand behind the patient, who is seated upon a firm stool, direct him to look upward, apply the thumb to the lower lid just at the external canthus, and make traction outward and slightly downward, so that the lid is made taut. This will evert and expose the punctum. The knife or probe,



FIG. 7.

held by the thumb and index finger of the other hand, is introduced into the punctum at right angles to the lid margin (*the first position*). (Fig. 8.) The instrument is then lowered to a position parallel to the margin of the lid (*the second position*) and directed into the sac, care being taken to keep up the tension on the lower lid. If the instrument meet with resistance at the sac entrance, it should be rotated slightly back and forth; when it enters the sac, and strikes the bony wall, you will be conscious of the relaxation of tension made by the probe or knife upon the lid. Keep the instrument firmly against the bony wall, relax the lid tension, but keep the hand in position to steady, control, and prevent movement of the head. Bring the instrument back into *the first posi-*

tion and feel with it for the entrance of the duct. If the instrument is in position it will not slip but give the feeling of being firmly held. You can now make pressure in the direction of the canal. Here again resistance should be met by the screwing and a slight rocking motion of the instrument.

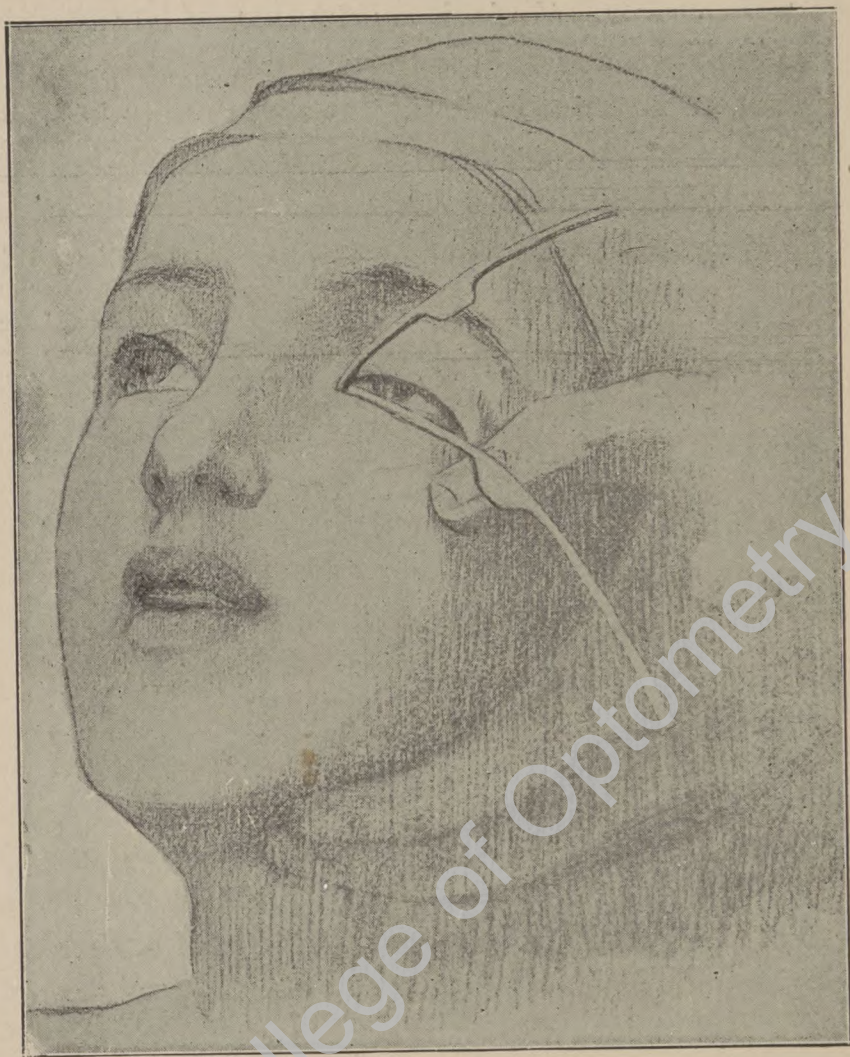


FIG. 8.

If you are using a narrow Bowman knife and desire to cut to the sac, turn the cutting edge toward the eyeball to an angle of 45° .

When you change the knife from the second to the first position, if it is not desirable to cut the canal, turn the back of the knife upward. For general use I prefer the Bowman knife.

To use an exploratory probe the punctum must be slit or dilated. To increase the caliber of the punctum a sharp-pointed, tapering probe can be used. To cut the punctum a narrow Bowman probe-pointed knife can be introduced in the first position and carried to the second position with the cutting edge toward the eyeball, until an opening of sufficient size is made. The probe, a Bowman No. 2, or No. 3, can now be used.

When the canal has been slit to the sac, a No. 6 probe can be introduced and passed to the nose unless it meets with a resisting stricture. You can, if you are in the canal, use five, ten or fifteen pounds of pressure, or even more. "Be sure you are right and then go ahead," is an axiom to be observed in treating lachrymal strictures with graduated probes.

The accident of making a false passage occurs quite frequently. Great care should be taken to prevent such a complication as an infection and cellulitis may result. Too much lateral motion caused by the struggle of the patient or the cramping of the knife in the canal may fracture the blade. The broken blade can sometimes be reached through the canaliculus opening and withdrawn with forceps, or an anæsthetic administered and the fragment withdrawn through the sac or forced into the nose by pressure from above. Solutions should not be injected into the sac or duct for several days after using the knife upon a stricture at either side of the sac or on the nasal duct.

From early times the use of a drainage tube of metal has been advised and used to relieve certain cases of chronic epiphora and unless cared for are liable to become imbedded and forgotten.

Miss O. M., 20 years of age, in childhood had an attack of dacryocystitis which was treated at home by poultices. The condition became chronic, and later she was taken to a physician who cut the canal to the sac, probed and introduced a stylet. That was years ago and before she came to this

country. To-day she presents herself suffering from external ulceration at the right internal canthus, constant discharge from the conjunctiva, and some swelling of both lids. The parts were too tender to allow an examination without an anæsthetic. We have had her etherized and can explore the ulcerated parts. I find on introducing the probe that there is some exposed bone at the seat of the sac, that I cannot pass the probe into the nose through the duct, and that I meet with what seems to be a metallic obstruction. We will open the integument and explore. I now find a long, metal tube with an arm of unusual length, the arm turned inward and imbedded in the orbit, the long part of the tube entering the duct. I shall clean out the duct with a sharp curette, remove the granular tissue and diseased bone, then dress with iodoform.

(Note.) This case recovered with permanent closure of the lachrymal duct, the sac being destroyed by the ulceration and the operation. Later the patient informed me that she supposed the metal tube to have been lost out two years before as it could not be found. The disease had caused so much loss of tissue that I did a plastic operation, taking a pedunculated flap from the forehead.

Foreign bodies may find lodgement in the canal or sac, and accumulations of lashes, dust, particles of granite or other insoluble substances become fixed and accumulate until concretions of considerable size are formed.

This patient, a farmer, comes with the complaint that something is sticking in his eye. The conjunctiva is flushed and there is some photophobia and a slight catarrhal discharge. There is nothing upon the cornea or lids to explain the irritation, but just protruding from the punctum is a sharp sliver. It is difficult to remove and under a glass it proves to be a kind of grain beard. Its removal was rendered difficult by the little spine-like processes along its sides.

CHAPTER II.

DISEASES AND DEFORMITIES OF THE EYE-LIDS.

The eyelids are made up of such a complexity of structure that they are liable to manifestations of about all the local diseases of the body, and are subject to the general laws of hygiene and treatment. In our study we shall refer only to such conditions as come under the care of an ophthalmologist.

The margins of the lids are made up of integument joining mucous membrane, lashes for protection of the eyes, hair glands, and, toward the inner edge, the mouths of the Meibomian ducts which furnish the oil-like rim to prevent the constant overflow of the lachrymal secretions, and the semicartilage, the tarsus. From their exposed position and the fact that they contain the terminals of circulation, they are subject to many irritations and sensitive to changes in local and general nutrition. (Fig. 9.)

Blepharitis marginalis is well illustrated in the case which I now present to you. (See Plate II, Fig. 1.) This boy is twelve years old; at five years he had measles. The eyes were at that time severely inflamed, the cornea gray and the secretions from the conjunctiva irritating to the external surface of the lids. As the acute inflammation ran its course, the margins of the lids became thinner and the integument healed; but the blepharitis remained as a chronic condition.

Inspection of the lids.—Cilia stunted, irregular, displaced and covered at the base by thick crusts. When these crusts are raised with the probe you notice that the lid is raw,

FIG. 9.



VERTICAL SECTION THROUGH THE UPPER EYELID, AFTER WALDEYER.

(From Landois and Stirling.)

A, cutis; 1, epidermis; 2, chorium; *B* and 3, subcutaneous connective-tissue; *C* and 7, orbicularis muscle and its bundles; *D*, loose sub-muscular connective-tissue; *E*, insertion of H. Müller's muscle; *F*, tarsus; *G*, conjunctiva; *J*, inner edge of the lid; *K*, outer edge; 4, pigment cells in the cutis; 5, sweat glands; 6, hair follicles with hairs; 8 and 23, sections of nerves; 9, arteries; 10, veins; 11, cilia; 12, modified sweat glands; 13, circular muscle of Riolan; 14, opening of a Meibomian gland; 15, section of an acinus of the same; 16, posterior tarsal glands; 18 and 19, tissue of the tarsus; 20, pretarsal or sub-muscular connective-tissue; 21 and 22, conjunctiva with its epithelium; 24, fat; 25, loosely woven posterior end of the tarsus; 26, section of a palpebral artery.

bleeding, and purulent. The lids are thickened and tender, the Meibomian ducts distended and filled with a large quantity of creamy discharge which is easily pressed out onto the lid margin. Frequently the odor from these secretions is very offensive. Certain types of children are more liable to idiopathic blepharitis than others, even without the exciting cause of measles and like diseases. Strumous children and those suffering from adenoids, or hereditary diseases, are liable to the non-suppurative form of the disease. A milder type of blepharitis occurs as the result of eye-strain from errors in refraction.

In this case the outcome of treatment should be a perfect cure if our patient will be faithful to the treatment. The parents must be impressed with the importance of thoroughness and persistence.

First we clean the margin of the lids with peroxide of hydrogen, one part to three of water. If the crusts are dry and firmly attached then we saturate two pledgets of absorbent cotton with the solution and have them held to the closed lids for ten or fifteen minutes. Then remove the softened crusts with the loosened cilia, clean the lids with boric acid (saturated solution), apply a two per cent. solution of silver nitrate with a cotton carrier, washing off the excess with a boric-acid solution. Then smear the affected surface with vaseline. At each dressing the Meibomian glands and ducts should be emptied by pressing the lids between the thumb nails.

The eyes may be shielded from strong light with London smoke glasses, but should not be bandaged. This treatment should be kept up until the margins of the lids are normal in appearance. The after treatment will be the use of the sodium biborate solution, and the application of some bland ointment, as sulphur sublimate. As soon as the general irritability has passed off careful refraction should be made, and, if indicated, glasses prescribed.

The next case will illustrate the milder and more chronic type, one in which there is no evidence of infection, only a modified secretion, excessive in quantity and too thick to be dissolved and carried away by the lachrymal secretions.

Mr. S., nineteen years of age, has suffered from marginal redness and scale formation from childhood. He has been subject to headaches during the last three years of school life. The headaches always recurred in the afternoon, were always frontal and accompanied by a smarting and burning of the eyes and a redness of the margin of the lids. Eye-washes have been used with temporary benefit. The inner surfaces of the lids are red and covered with minute elevations. The lids are slightly thickened and covered with fine scales. The lashes are stunted, scattered, and covered by a fine crust or scale at their base. We have here the result of chronic irritation from an error of refraction which can only be cured by the adjustment of proper glasses. Under atropine the correction required equals: Right eye, +1.00 sph., +1.50 cyl., ax. 90°. Left eye, +1.00 sph., +1.00 cyl., ax. 90°. The collyrium which we shall recommend is sodium biborate (saturated solution) used as an eye bath twice daily. The glasses should be worn constantly.

The sty, an infiltration of the hair gland (see Plate II, Fig. 3), is also the result of infection and impaired nutrition. Stys come most frequently to strumous patients who are also suffering from errors of refraction. They may occur as isolated cases or recur frequently in the same eye as the result of reinfection.

A small, painful swelling appears at the base of the eyelash, and if not aborted by the application of cold and the pulling of the hair, will go to suppuration.

The patient presenting himself for treatment has a sty in the latter part of the first stage. We will pull the lash that occupies the center of the swelling and two lashes on either

side, apply a five per cent. solution of argentum nitrate with a small, pencil-pointed applicator, cauterizing the points from which the lashes were removed, and prescribe a borated vaseline ointment to be applied to the lids once in every two hours. I also direct the patient to bathe the eye with cold water, or apply a small piece of ice tied in a rubber finger-shield for fifteen minutes every two hours. In this way the inflammation may be arrested. Should it go on to supuration the little abscess can be opened and treated as a phlegmon, continuing the use of the borated vaseline or the soda borate solution.

I desire to lay down a general rule right here. *Never apply, or order, a poultice without giving specific instructions regarding its use;* for no remedy is capable of doing more harm to the cornea than an improperly applied poultice. Heat or cold may be used in various ways, but never in the sense or after the manner of a poultice according to lay practice.

Streptococcus or other infection may follow a sty or any abrasion of the lid and may cause excessive swelling, ulceration, and destruction of the lids. The period of invasion is usually short and the suppurative stage follows quickly. The microscope is required to confirm the diagnosis. The treatment would be the same as infection of other parts; cold boric acid compresses in the early stage, and hot in the suppurative stage. As soon as the suppurative points appear they should be opened, curetted, and treated to applications of 1 to 500 solution of formaline, applied with a pencil-pointed cotton carrier. Take care that the solution does not reach the cornea.

Edema of the lids not attended by inflammation of the eyes is a symptom of albuminuria and impaired circulation.

Within the lid structure are the Meibomian glands, imbedded in the conjunctival surfaces of the tarsal cartilages and opening by minute common ducts on to the free margin of the lids.

These ducts and glands are subject to catarrhal inflamma-

tion and tubercular and other specific forms of infection. When these glands are over-stimulated the secretions may become excessive and a source of annoyance. Stenosis of the common duct causes the retention of secretions and the slow formation of a tumor a little remote from the margin of the lid; or an acute inflammation may result from an infection of one or more of the gland groups and an acute, painful tumor (see Plate II, Fig. 2) called *chalazion* form. These conditions may arise from lowered general tone, imperfect elimination, local or general infection.

The local treatment is directed toward the evacuation of the tumors, and frequent flushing of the eye with a saturated solution of boric acid; the constitutional treatment is given to the improvement of the general condition.

This patient, aged twenty-three, has passed through her first pregnancy, which was uneventful. About two weeks after the birth of the child two small tumors appeared in the upper lid of the left eye, and a week later three elevations were noticed in the upper lid of the right eye. Two tumors, one in each eye, filled rapidly to the size of a navy bean, the other tumors slowly disappeared. The remaining growths are slightly tender, and fluctuate. Inspection of the conjunctival surface shows discoloration and thinning of the conjunctival wall. Over the site of the aborted tumors can be noted some discoloration of the conjunctiva, and what appears to be yellow, dilated ducts. Grasp the lid between the index finger or thumb-nail of the right hand and the thumb of the left hand and make firm pressure. You will be able to express a quantity of thick, cheesy substance. This massage should be made every third day and followed by a borate of sodium wash.

The treatment of chalazion, whether the result of stenosis or infection, is surgical. The instruments required are a short, narrow knife, a small curette, and a cotton carrier.

Grasp the lid, including the tumor, between the thumb and



Fig. 1.



Fig. 3.



Fig. 2.

PLATE II.

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index finger with the tumor firmly held in position, direct the knife into the tumor through the lid margin and make an incision large enough to admit the curette. With the curette thoroughly clean out the tumor, reaching all its parts. Introduce the cotton carrier saturated with a two per cent. solution of argentic nitrate. Before freeing the lid clean away the overflow of silver solution.

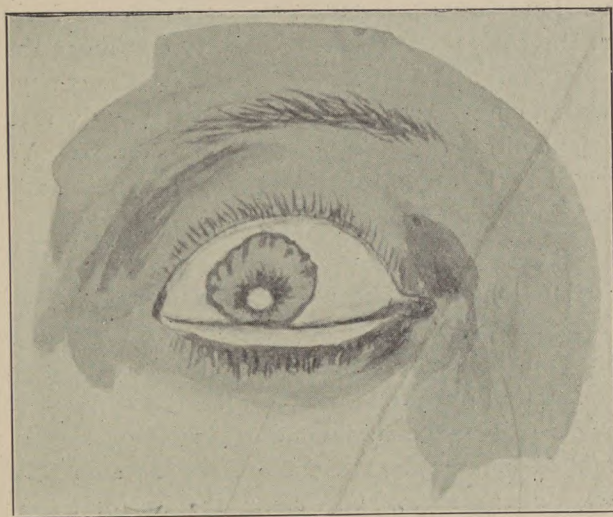


FIG. 10.

In cases of tuberculosis of the glands it has been necessary to destroy the entire system with curette and caustics.

This case, Miss O., aged thirty years, is a good example of the results of a neglected Meibomian cyst. The tumor appeared about two years ago, grew to a large size, collapsed, and refilled, but never to the same size as before. It was not tender, but kept the lid thickened and caused irritation of the eye, keeping it closed in the morning. The patient has been to a physician who removed a polypus from the under surface of the lid. It evidently has returned, for, protruding from

beneath the upper lid, when the eye is open, you can see the ragged edge of a growth. (Fig. 10.)

Eversion of the lid exposes a flat, mushroom-shaped mass, thin and bleeding, attached to the upper part of the tarsal conjunctiva by a narrow pedicle. Protruding from the centre of the tumor is a gray, jelly-like substance. The probe passes through this into quite a cavity which extends upward under the lid and rests on the orbital fascia. The external growth is granulation tissue arising from the opening of a Meibomian cyst into the conjunctival sac. We will cut away the mass close to the mouth of the opening, clean out the cavity of the tumor with a curette and with an applicator apply a solution of argentic nitrate, twenty grains to the ounce. You will be surprised at the extent of these flattened tumors, especially when they form high up in the duct.

It is no longer considered necessary that the so-called sac walls be dissected out. The use of the curette must be thorough, and, if necessary, an anæsthetic is to be given.

The reaction from the operation for the removal of these growths is usually inconsiderable and is relieved by the application of cold compresses. Should there be some discharge on occasion of the second visit clean the lips of the wound, and again use the cotton carrier with the silver, or carbolic acid ten-per-cent. solution, being careful not to allow it to reach the cornea. There should be no super-saturation of the applicator.

Chalky and amyloid concretions form in the Meibomian ducts and glands and cause considerable irritation, but most noticeably on the conjunctival surface of the lids. They are too small to cause tumefaction and are manifested by an irritation of the conjunctiva over a circumscribed area, and later as they work their way from deeper parts to the surface appear as little white bodies in the sub-conjunctival tissue. Here they give irritation as of a foreign body in the conjunc-

tival sac. These little offenders can be removed with a Grafe knife from the conjunctival surface of the lid. Frequently four or five millet-like grains come from the same opening. These cases are greatly improved by massage of the lids. To do this I put the mucous surfaces of the lids in apposition between the thumbs and rub them firmly one against the

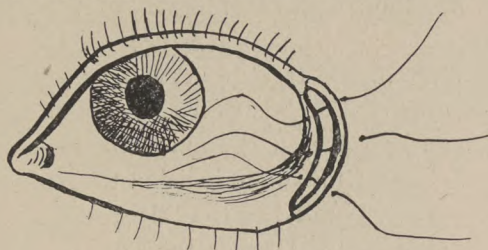


FIG. 11.

other. I have used this form of treatment for many conditions both of the conjunctiva and the lids, and have found it especially useful in Meibomian diseases.

Eye lashes may be abnormal in growth and direction. *Trichiasis* and *distichiasis* are usually the result of some chronic disease of the lid, as trachoma, chronic conjunctivitis,

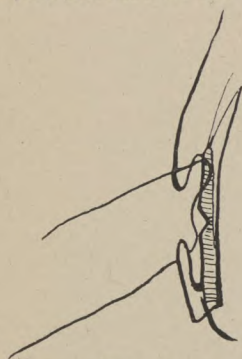


FIG. 12.



FIG. 13.

and diseases of the tarsal cartilages or glands. *Distichiasis* may, however, be a congenital condition.

The case I now present to you has suffered from granulated lids since early youth, and now, at thirty years of age, has badly incurved lids, the lashes stunted, misdirected, and

abnormally numerous. The cornea, as a result of the condition of the lids, and the misdirected lashes, is vascular and opaque. The aperture of the lids is narrow. With every movement of the lids the cornea is swept by the lashes or scratched by their stunted points. Much of the patient's suffering can be relieved and his sight improved by removing this source of irritation, and the removal of the tension from the eyeball.

The first step in our treatment will be directed to the relief of the tension of the lids over the eyeball by a canthoplasty. This can be done in the following manner: With a strong knife or scissors make an incision through the integument and sub-tissues, parallel to the lid opening, five to eight m.m. in length (Fig. 11). Dissect the conjunctiva from the sub-tissue, sever the fibres of the orbicularis muscle, introduce a suture at the angle of the conjunctiva and bring it to the angle in the integument, and tie. Then stitch the conjunctiva to the integument, one suture above and one below. We have in this way increased the aperture as much as the bony walls will permit.

Our next step will be for the relief of the inturning lids and lashes. For this purpose I prefer what is known in this country as the "Hotz operation" or some modification of it. This is done by enclosing the lid in a lid-clamp devised for this purpose. Make an incision in the lid three to five m.m. back from the ciliary margin and parallel to it down to the tarsal cartilage. Dissect the fibres of the orbicularis muscle from the upper margin of the cartilage to the hair glands of the ciliary margin, exposing its anterior surface. In this case the cartilage is curved inward and we shall groove its surface from one end to the other. As there are some badly displaced lashes we shall split the free margin between the lashes and the conjunctival border.

The next step in the operation is of extreme importance: the introduction of the sutures. Remove the clamp, grasp the center of the lower lip of the wound with the forceps, pass the needle from above downward through the lip of the wound,

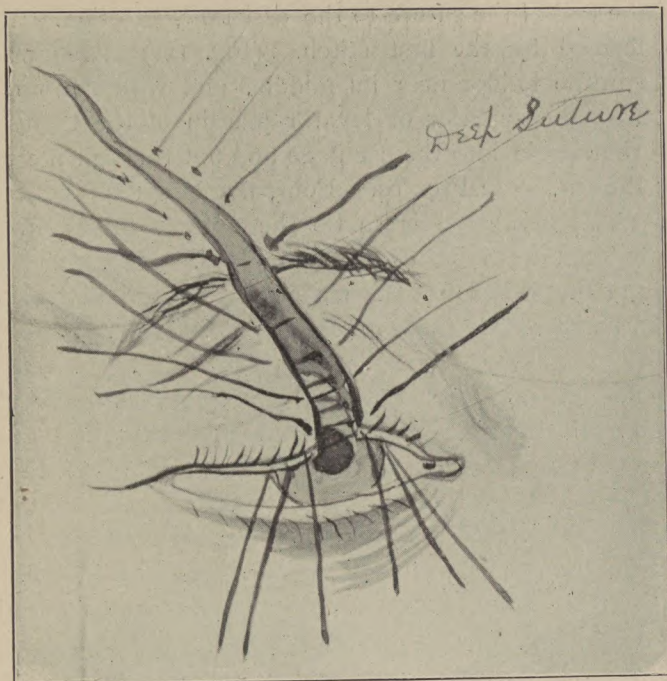


FIG. 14.



FIG. 15.

hand the end of the suture to the assistant, together with the loop formed by the first stitch. (Fig. 12.) Re-grasp the needle in the holder near its middle, and with fixation forceps grasp the superior or levator margin of the tarsus and carry the needle into the cartilage and out through the upper lip of the cut, as in Fig. 12. Four, five or six sutures can be used. The next step is to tie the sutures firmly in position, but not until they are all in place. (Fig. 13.) If at any point the eversion is not sufficient the conjunctival margin can be cut and a small mucous graft inserted.

The lids may turn outward, *ectropion*, as the result of conjunctival disease, or as a result of contraction of the integument from a traumatism or burn. (See Plate III, Fig. 1.)

The case which I present to you is an ectropion of the upper lid, the result of an injury received in early youth. Mr. H. is forty-six years of age, at fourteen he received an injury to the upper lid, cutting it from its center upward to the scalp. Following the accident the edges of the lid portion of the wound were not brought into apposition. The brow is displaced upward from the unrestrained contraction of the frontal wound. During all these years the lids have not closed day or night, and as a result of exposure the cornea has been frequently inflamed and ulcerated. In order to place the lid in its proper position I shall dissect the cicatricial tissue from its adhesions to the supra-orbital ridge, dissect right and left so as to allow the eye-brow to fall into its normal position and with a strong suture anchor to the periosteum. We now have the lids sufficiently lowered to cover the eye and close it. (Fig. 14.)

The next proceeding in the operation is to freshen the lower and gaping part of the wound, remove the cicatricial tissue, and free the lid from its contracting bands; then coaptate the freshened edges of the severed lid, and stitch con-

junctiva to conjunctiva and integument to integument. It may be best at some time to do a canthoplasty, as in Fig. 11.

This patient, aged seventeen years, about eighteen months ago was burned by the explosion of a casting in one of the foundries. You will notice that the upper lid is elevated and everted, resting nearly as high as the brow. The bands of constriction are very firm and allow of but little motion. The conjunctiva and cornea are greatly irritated, but up to this time there has been no serious destruction of the corneal tis-



FIG. 16.

sue. The burn involved the superficial tissues only and the cicatricial bands are not deep. (Fig. 15.)

I shall now dissect out the greater part of the contracted and fibrous tissue, free the sub-tissues from adhesions and bring from the temple (Fig. 16) a large flap to fill in the gap. The flap transplanted should be thin and include only the integument and its sub-structures. It should be carefully fitted to its new position and held there by many fine sutures.

Too much stress cannot be laid upon the importance of perfect preparation and thorough asepsis in the operation and after-treatment, for even a pedunculated flap may become infected and slough.

Chronic inflammation of the conjunctiva may cause a redundancy of tissue and eversion of the lower lid. The overflow of tears caused by the displaced and diseased mucous membrane produces irritation of the integument and it becomes brawny and contracted, if not ulcerated.

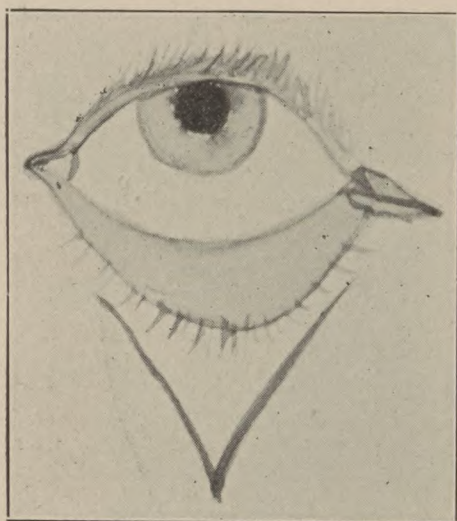


FIG. 17.

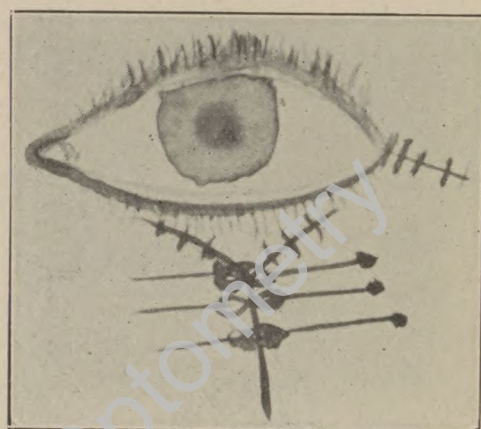


FIG. 18.

This case, Mr. A., aged sixty-four, seaman, has had catarrhal ophthalmia since childhood. About eight years ago the lids became incrustated and the skin chapped from overflow of tears and exposure to wind and weather. The corneæ are scared and vascular. The conjunctiva is deeply red and both lids are fully everted, the overflow of secretion keeping them constantly moistened. The old silk handkerchief with which he constantly dabs them is an added source of irritation. (Plate III, Fig. 2.) He has been under treatment nearly every winter, while his ship is in port, with no permanent benefit. During the past month I have applied argentic nitrate five per cent. to the everted lid, smeared with vaseline the integu-

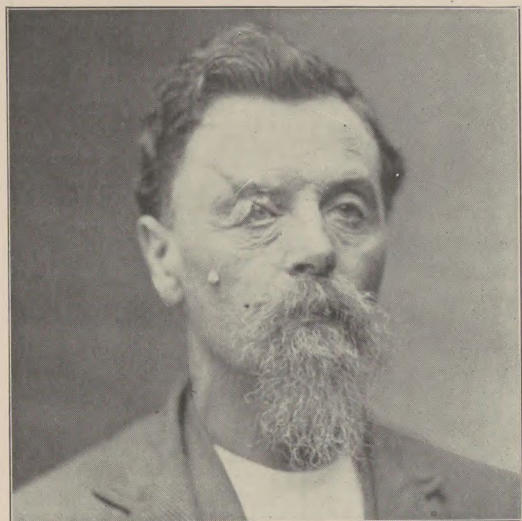


Fig. 1.



Fig. 2.

PLATE III.

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ment below the lid and given it thorough massage. It is now more pliant, but the lid is never drawn into its proper position. He has consented to a radical operation for relief.

We will make a V-shaped incision, as per Fig. 17, dissect up the flap on either side and introduce three pin sutures converting the V into a Y (Fig. 18), in this manner forcing the lid upward. When in position there is a redundancy of tissue. This we shall take up by removing a wedge-shaped section of the lid at the external canthus, as in Fig. 17. Seal the lower wound with collodion dressing. Three or four times a day, clean the conjunctival sac with a saturated solution of boric acid. I shall not use a bandage, for with the assistance of the lachrymal secretions we will be able to keep the wounds clean with the open treatment and the cornea will not be endangered.

Scattering, or wild, lashes may develop in any eyelid. They appear along the inner margin of the lid as very pale, almost invisible, hairs.

This patient came complaining of severe supra-orbital neuralgia and a redness of the conjunctiva, and the sensation of a foreign body in the eye. Careful examination by the family physician revealed nothing to account for the irritation. From our inspection it would seem that he did not look at the lid margin, for I find several pale, transparent lashes brushing the conjunctiva and cornea. I advise the destruction of these lashes by electrolysis. The negative pole of a galvanic battery is connected with a very fine jeweler's brooch or needle in a holder, and the needle is thrust into the hair gland; the positive pole is applied to the face through a sponge. On account of the smallness of the lash and the difficulty attending the introduction of the needle, a stain or dye may be applied so as to render the hairs more readily visible.

Deformities of the lid which take place as the result of destructive trauma, burns from hot metals, acids or other

escharotics, require the attention of the surgeon to make necessary repairs either for cosmetic or protective purposes. Not many years ago all of these cases were treated to the operation of the pedunculated or sliding flap, or both; later the operation has been modified by the bodily transfer of the integument from one part of the body to another, the buccal membrane to repair the destroyed conjunctiva, and grafts from the inside of the thigh or protected parts of the arm to repair the lids and adjacent integument. I prefer the flap method



FIG. 19.

where it can be used, as there is much less danger of sloughing and contraction.

This case is one of deformity at the external canthus, the result of a severe burn from a nugget of hot metal. The injury was sustained about eight months ago and resulted in the union of about one-third of the upper and lower lids, (Fig. 19.) at the external canthus.

The operation in this case is as follows: The canthus is separated as in a canthoplasty, the cicatricial tissue being dissected out both above and below. The conjunctiva is freed from the ocular wall and a Thiersch graft taken from the mouth and fastened in position. I next slide a triangular

flap from the temple, split it and secure it to the cutaneous and mucous edges. (Fig. 20.)

The Thiersch graft should be at least three times the size of the surface to be covered, and the pedunculated about two times. The amount of contraction will depend upon the promptness with which the nutrition is established. Under good conditions extensive repair can be made.

Ptosis, or drooping of the lid, occurs occasionally as a congenital condition. It may be the result of paralysis of one

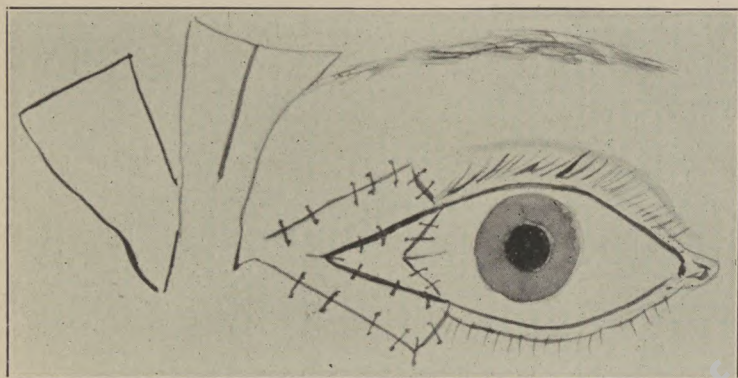


FIG. 20.

or more branches of the third nerve, or of pressure along its course from orbital tumors, specific, malignant, or benign.

This case is one of congenital ptosis. Boy, aged seven years, both eye-lids drooping, the left more than the right. To complicate matters still more, there is a narrowness of the aperture. For the relief of this case I shall first do the canthoplasty (see Fig. 11), and then the operation for the correction of the ptosis proper. The operation for ptosis in this case consists of so firmly anchoring the tarsus to the frontal aponeurosis that by elevating the brow the lid will be opened.

The method we shall follow in this case is the one devised by Dr. W. H. Wilder, of Chicago. I give you his description of the operation: (Fig. 22.)

“This incision may be one inch and a half or even more in length, but should be so placed that the resulting scar will be concealed by the eyebrow.

“A retractor being used to draw down the lower lip of the wound, the skin and muscle are separated from the fascia by



FIG. 21.

careful dissection until the tarsus is brought into view. This is more easily accomplished if an assistant puts the lid on the stretch. Sutures of fine sterilized catgut or silk armed at each end with a curved needle are passed in the following manner. The first needle is introduced deep enough into the tarsus to secure a firm hold at a point about at the junction of the outer and middle third and a little distance from its convex edge. It is then drawn through and with it several gathering stitches are taken in the tarso-orbital fascia, after which the needle is

made to pass through the muscle and connective tissue of the upper lip of the wound.

"The other needle on the same suture follows a parallel course in the same manner, entering the tarsus about three mm from the point of entrance of the first, then gathering the fascia into small folds and emerging in the tissue above, thus making a loop by which the lid may be drawn up.

"The second suture is passed in the same way, making a loop at the junction of the middle and inner third of the tarsus.

"The requisite elevation of the lid may be now secured by drawing on the loops and tying the sutures, which are to be buried in the wound.

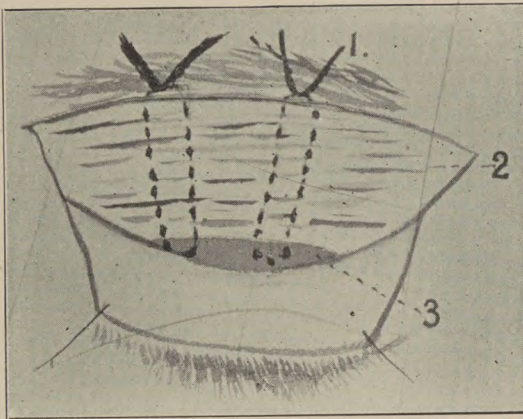


FIG. 22.

- 1. Suture.
- 2. Orbital fascia.
- 3. Superior margin of cartilage.

"The lower lip of the wound is now united to the upper with fine sutures. The slight scar that remains after healing is almost entirely hidden when the eyebrows grow again."

Ptosis frequently occurs in hysterical patients, especially those suffering from eye-strain due to refractive or muscle

error. Assure the patient that following the relief of the local irritation all symptoms of ptosis will disappear, and the prediction usually comes true.

Blepharospasm is usually the result of acute or chronic irritation of the cornea. It may persist, however, after the cause has been removed. Cold eye baths are of use in completing the cure.

CHAPTER III.

DISEASES OF THE ORBIT.

The cavity of the orbit is in the shape of a quadrangular pyramid, its base the orbital opening and its apex the optic foramen. The rim of the orbit is made up of a strong, bony structure to protect the eye from injury. The globe and optic nerve are suspended in the capsule of Tenon which rests in a cushion of fat and connective tissue. The eyeball is held in position by six recti muscles. Above and to the temporal side, suspended in its capsule, rests the lachrymal gland. The cavity walls are lined by periosteum. The nasal wall is thin and bounded by the ethmoidal and sphenoidal cells, the superior by the frontal sinus, and the inferior wall by the antrum of Highmore. (Fig. 23.)

Inflammation of the orbital cavity may result from local infection or invasion of septic matter from some of the adjacent cavities or sinuses, following or during the course of diphtheria or scarlatina, or from an alveolar abscess discharging into the antrum of Highmore. Penetrating wounds, or the impaction of a foreign body, may carry sepsis.

This case, a girl of fourteen years, has just recovered from an acute inflammation of the throat and nose. Three days ago she complained of pain about the eyes, and the lids were tender, swollen, and œdematous. Yesterday she complained of severer pain; and the eye was displaced up and outward. The temperature has been 102° . She has been sleepless and delirious the last twenty-four hours. About four hours ago, there was some discharge of pus and blood

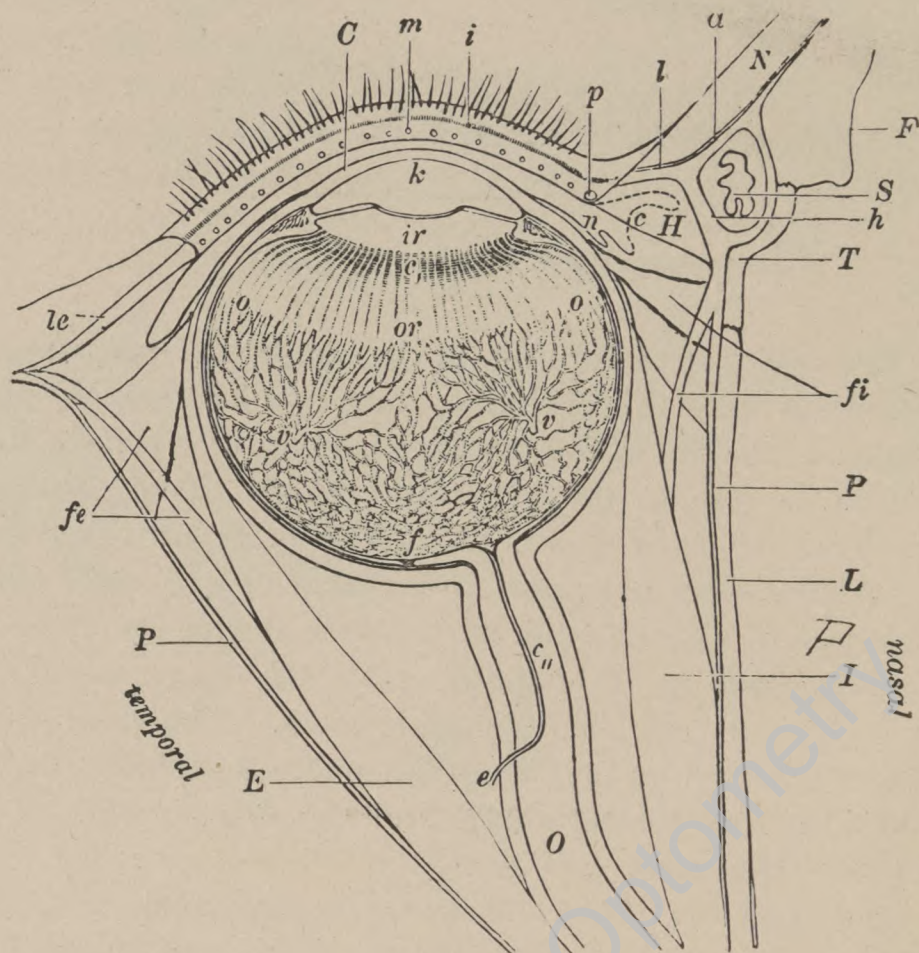


FIG. 23.

EXPLANATION OF FIG. —The nasal wall of the orbit is formed by the lamina papyracea (os planum) of the ethmoid, *L*, the lachrymal bone, *T*, and the frontal process, *F*, of the superior maxilla. The last two bones bound the fossa sacci lacrymalis, in which lies the lachrymal sac, *S*. The bony walls of the orbit are coated by a periosteum (*periosteum*), *P*, from which the palpebral ligaments take their origin. The internal palpebral ligament, *l*, divides into an anterior limb, *a*, and a posterior limb, *b*, which together inclose the lachrymal sac. From the posterior limb arise the fibers of Horner's muscle, *H*. *le*, external palpebral ligament; *fi* and *fe*, the slips of fascia, likewise originating from the periosteum, going to the internal rectus muscle, *I*, and the external rectus, *E*. The skin, *N*, of the dorsum of the nose passes into the lower lid, at whose free border are seen the cilia and the orifices of the Meibomian glands, *m*; between the two extends a gray line, *i*. At the inner extremity of the lid lies the inferior punctum lacrimale, *p*, and farther along in the conjunctival sac the caruncle, *c*, and the plica semilunaris, *n*. From the eyeball, the lower half of which is exhibited, the lens and along with it the vitreous humor have been taken out, and the pigment-epithelium has been removed by penciling. The anterior chamber, *k*, the iris, *ir*, and the ciliary body, consisting of the corona ciliaris, *c₁*, and the orbiculus ciliaris, *or*, are visible. Back of the ora serrata, *o*, is the chorioid with its veins which are aggregated into vortices, *v*. *f*, fovea centralis retinae; *c₁₁*, central vessels of the optic nerve, *O*, entering it at *e*.

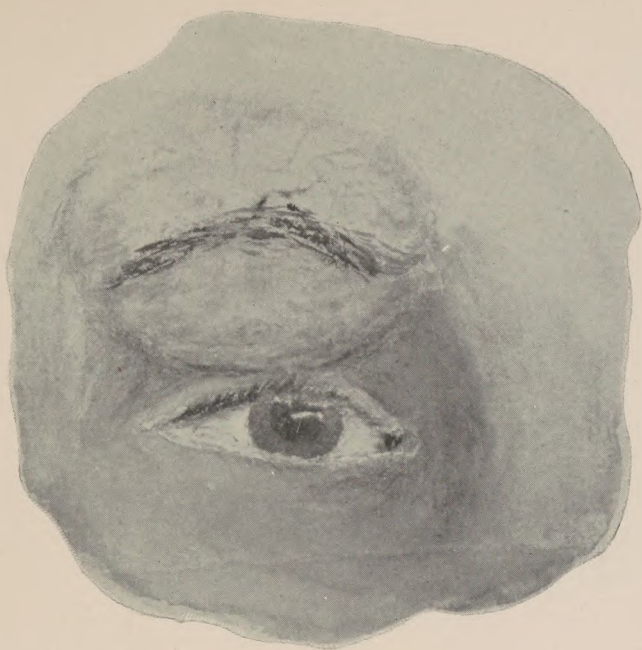


Fig. 1.



Fig. 2.

PLATE IV.

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through the nose and into the throat, followed by relief from pain and a lowered temperature. (Plate IV, Fig. 2.)

This case is one of *orbital cellulitis* from an infection through the nasal sinuses. It is possible that the abscess may discharge freely through the nose, but experience leads me to favor an opening at the most dependent portion of the orbit. The opening is made through the integument with a von Graefé knife, and enlarged to admit of drainage. The incision is followed by a free discharge of pus and blood. I shall now feel with a strong probe for the opening which is in the orbital wall, and try to secure drainage in that direction, if the infection has been brought about by necrosis of the thin plate of bone which separates the orbit from the nasal sinus. A careful inspection does not reveal the opening.

I shall now irrigate the cavity of the orbit with a hot solution of boric acid. There is little danger of carrying sepsis to the deep parts of the orbit, for Nature has safeguarded the parts by surrounding the abscess with plastic matter which will not allow the fluids to penetrate deeply. A little increase of pressure is followed by, first, a small and now a large, stream of water through the nose. The fluid has found the opening which I could not with safety find with the probe. We now clean the orbital cavity with a $\frac{1}{3000}$ solution of bichloride, and introduce a wicking drainage. The cavity will be irrigated morning and night and the packing renewed at each dressing until the suppuration ceases.

Foreign bodies may find lodgement in the orbit, and remain imbedded and encysted until discovered by accident, or till the growth of the cyst causes investigation.

This case, Miss C., aged nineteen years, noted a small tumor to the temporal side of the left eye and just below the lachrymal gland. Lately the swelling has increased in size until it interferes with the movement of the eye, and the

opening of the lid. History reveals nothing, and inspection gives no clew to the nature of the growth.

The tumor has been too slow in growth to be malignant; there is no evidence of syphilis; and the lachrymal gland does not seem to connect with it.

The patient has been prepared for operation—ether administered, and I shall now make an exploratory incision.



FIG. 24.

The cut through the integument will be made in, and parallel to, the fold of the lid, so that there will be no visible scar. We feel a small almond-shaped tumor, about three-quarters of an inch in length, one-half inch in its lesser diameter, and one-third inch in thickness, firmly adherent to the orbital fascia. Removing it from its attachment I find it to be a hard, slightly fluctuating tumor containing a hard substance; and, upon opening, it proves to be a piece of graphite, a pencil point. The foreign body may be the trophy of some early

school-day accident. We close the wound with fine sutures and seal it with a collodion dressing.

This patient (Fig. 24), aged twenty-four, male, at ten years of age, fell, striking his forehead on a hard object. He remembers but little beyond the fact that a thickening of the orbital ridge, to the nasal side of the foramen or groove of the supraorbital nerve, was noticed at twelve years of age, and has continued to increase in size till now it seems to be about one-third of an inch at its base and projects about one inch toward the orbit. The growth is unyielding and immovable. It is evidently an exostosis resulting from the early injury.

Chloroform has been administered. I make an incision one-and-a-half inches in length over the lower end of the tumor, retract the flap, and expose the projecting bone. It is covered with a thin layer of periosteum and is about one-third of an inch in diameter. It is of ivory hardness and does not yield to the cutting instrument. I will now try to chisel it away at its base, cutting into the more normal bone, and taking care not to break into the frontal sinus.

The specimen as it now appears after removal is one-and-one-eighth inches long and three-quarters of an inch at its base. The wound can now be closed by sutures and sealed with collodion. If our operation has been clean there will be no noticeable scar.

We have for our study to-day a case that has been under previous observation. The patient, male, thirty-two years old, was struck by a splinter of iron just above and to the temporal side of the eye. The wound as he described it was half an inch long and just below the brow. He was of the opinion that the fragment struck the bone and fell to the floor of the shop. No attention was given to the wound. The accident occurred about nineteen days ago. Ten days ago he came into the clinic complaining of pain in the eye and tender-

ness to touch and motion. The eye was flushed, and there was a deep pink zone about the cornea, indicating ciliary congestion. Iris normal, cornea clear, slight chemosis of the conjunctiva in the lower retrotarsal fold, just a noticeable exophthalmus, the lids puffy. Ophthalmoscopic examination showed choked disk, tortuous veins, and two small, discolored spots near the macula. Vision was 20/200. The wound had closed firmly and was not sensitive. I was convinced that the fragment had lodged somewhere near the optic nerve, in the deeper part of the orbit and advised immediate exploration, but our patient would not consent and left the clinic without instructions. In such cases I prefer not to be party to any but radical treatment.

He returns again to-day after poulticing the eye for several days, until now the cornea is macerated and sloughing, and the globe partially protrudes through the swollen lids. The general appearance is that of panophthalmitis well advanced. He has been prepared for operation, and I will enucleate the eye if necessary; but, before severing the nerve, will try and locate the fragment, for I suspect that the sheath of the nerve is wounded near the globe.

The steps of an enucleation are more conservative than of an amputation, the operation first in vogue for the removal of the globe. The operation as now made is considered with reference to the insertion of the artificial eye. The conjunctival cavity must be as extensive as possible so that a large eye can be held in place, and the recti muscles kept in relation to the conjunctiva and annular ligament. Therefore, I proceed as though I intended to enucleate, and will remove the globe if the fragment cannot be removed without. With this possibility in view, I dissect the conjunctiva from its sclero-corneal junction over the insertion of the external rectus, sever the muscle from its attachment to the globe, but not from its connection with the conjunctival sub-tissues, then make an incision from the edge of the conjunctiva along the lower border of the external rectus muscle, and with fixation forceps

hold the wound open. We can now explore the orbit with the probe and magnet. I have an electro-magnet, connected with four dry cells, with which I hope to locate, and possibly remove, the piece of iron. After searching with the probe we have only produced a flow of pus and blood. I will now introduce the magnet. There is a sharp click, but no metal follows the withdrawal of the instrument. The fragment seems to be located on the floor of the orbit, and a little to the nasal side. The probe locates a rigid, metallic substance which, when it is rubbed, leaves its mark on the softer metal. I shall try and locate it with my finger. To do this, I am obliged to open the conjunctiva along the inferior cul-de-sac. The fragment can be felt firmly imbedded in the floor of the orbit and resting under the optic nerve, and, I should judge, transfixing the inferior rectus muscle.

With my finger as a guide I introduce these strong forceps, and try to withdraw the foreign body. It is now in the grasp of the instrument and I gently rock it and coax it free, as I do not care to have it break off. I am able to raise it, and, by changing its grasp in the forceps, withdraw it. We now flush the cavity with $\frac{1}{1000}$ corrosive chloride, reattach the external rectus close to the conjunctival wound, and make a free drainage opening through the integument, packing the wound with iodoform wicking.

The prognosis in this case is unfavorable, but we may be able to save the globe and some useful vision, though the motion of the eye is liable to be impaired.

I advised an enucleation as the safest procedure, but, at his request, have given him the benefit of an attempt to save the globe. The fragment of steel is seven-eighths of an inch in length and one-eighth in breadth, quite sharp at one end. It evidently struck the brow bone and was deflected downward.

(Note.) Six months after the operation the vision was 20/80 and would have been better but for the corneal opacities, the result of the use of poultices. The motion is very

much impaired, the eye being held down and outward. He could get about with this eye alone, but there is still danger from it, as it is quite irritable, though there is no ciliary injection.

About two weeks ago this boy, thirteen years of age, was struck in the eye by a splinter of wood. The external wound at the outer canthus shows the place of entrance to be just at the junction of the lids in the conjunctival fold. It has closed up with but a slight cicatrix. The splinter was freshly made and presumably aseptic. It was quite sharp about eight inches long and one-half inch in width, so the mother thinks, when it was withdrawn. For some days after the injury there was no pain except at the point of entrance. As the physician who dressed the wound could find no evidence of any portion of the splinter in the orbit and, as the parents thought there was nothing broken off from the end, it was decided that it was a simple penetrating wound.

For some days there has been tenderness and increasing exophthalmus. To-day we find the eye pressed forward, the orbit deeply tender, and the lids œdematous. Vision is impaired, the ophthalmoscope shows the disk choked and swollen.

We will now, under anæsthesia, make a free incision at the wound of entrance. Going deeply with the knife and a strong probe a large quantity of dark blood comes away, but no pus. I can feel nothing that would indicate the presence of a foreign body. We will therefore pack with iodoform gauze hoping that, if pus is present, it will find the way out.

(Two days later.) The condition in both eye and orbit is much graver, the exophthalmus is increased and the pain is severe. Ether is again administered, and, with permission of the parents, we will if necessary enucleate the eye, if the conditions cannot be improved without. I first sever the external rectus muscle and explore the capsule of Tenon, thinking the pus may have formed within its cavity, or in the

pyramid of the muscular fascia. (See Fig. 23.) Nothing comes of this exploration between the muscular walls, but, far up in the orbit, we find a resisting fibrous mass, filling the apex of the orbit nearly to the globe. I shall remove the eye and explore the deeper parts. There is undoubtedly some infection, and possibly a fragment of wood beyond reach. There is much danger of its having penetrated the narrow apex, or even to the brain, though no symptoms of meningitis are present. The eye removed and the apex of the orbit reached, there is a flow of pus and blood, but our search is not rewarded by finding the foreign body. I now irrigate with $\frac{1}{1000}$ bichloride solution and pack with iodoform gauze, the dressings to be changed every morning and night.

(Note.) My assistant reported that, while dressing the cavity some days later, he found a splinter of wood in the orbit; it was one-third of an inch long and one-eighth of an inch in diameter. The cavity granulated and the wound healed kindly.

There was great danger of meningitis in this case; the only reason that it did not occur was that Nature provided behind the same kind of a fibrinous barrier to encapsulate the foreign body that had interfered with reaching the pus on our first exploration.

Tumors, specific, benign, or malignant, may develop in any part of the orbital cavity. There are difficulties in diagnosis that can only be overcome by exploratory incisions.

The only chance to benefit a patient suffering from a malignant tumor is an early, complete removal of the contents of the cavity of the orbit, and that before any of the surrounding parts are involved. The exenteration of the orbit should take place before the meibomian lymphatics are infected. Even though the growth does not return in the orbit, it may manifest itself later in some remote organ, as the spleen or liver, at any period. There seems to be no limit as to time or place, and you cannot be sure that the orbital

growth, which is now active, is not secondary to some parent nest, remotely situated, which is dormant.

This case (Fig. 1, Plate IV.), Master M., aged twelve years, came to our clinic two days ago and returns to-day that I may present him for inspection. You will notice a fullness above the left upper lid, and a small scar made by an exploratory needle. The tumor is not tender, has been of rapid growth (a sign of malignancy), and only lately retards the movement of the lid and displaces the eyeball downward and toward the temporal side. The brow above the orbit is distended and spongy, the blood vessels are dilated and tortuous. The skin is discolored and low in vitality. These are all signs of malignancy.

The examination of the fundus shows a clear field, but a slightly congested disk. I had thought to find a tumor springing from the retina to indicate that the external growth was a glioma or possibly a sarcoma, for these not infrequently appear primarily in the eye and in the orbit secondarily. Not finding any clue to the nature of the tumor within the eye, an exploratory needle has been passed into the tumor through the lid, and we have withdrawn about 20 m. of dark, pigmented fluid. By exploring with a probe passed through the canula, we reach the superior orbital wall and find it denuded of periosteum and crumbling to the touch. This was to be expected from the spongy condition above the brow. We have a pigment-celled, or melano-sarcoma to deal with, and the prognosis is very grave. The parents can take the child from the room.

The only benefit to be derived from an operation, in this case, is the removal of the unsightly mass as it presents itself later in the disease; and this is more for the benefit of the friends and attendants than of the patient. I will show you a colored drawing of a patient taken about seven months



PLATE V.

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after I first saw him in the stage of the disease in which the patient is who has just left us.

In neither of these patients is there any personal or family history that can account for such growths.

Operative interference in cases of this kind, and with the growths in this location and state of development, only hastens death, and in that way lessens suffering. When we operate we regret it, and when we do not the patients and parents are sure to do so.

The case represented in Plate V. was about fourteen years of age, and, when he came to me, presented exactly the same appearance, and gave the same history, this child does.

The parents were informed regarding the prognosis; that it would be impossible to remove all the tissues implicated, and that the disease could only terminate in the death of the child. I also advised them, as I have the parents of the child we have just examined, that experience showed the operated cases of this class did not live as long as the non-operated, but suffered less. The parents have chosen in both cases to have no interference. Had the tumor been seen early, before extensive changes had taken place in the walls of the orbit, I would have advised removal of it, as well as all the adjacent tissues. There was then the chance that the growth would not return, and that other and more remote parts had not become involved, or, if they had, the infection would lay dormant for some time. Those who have not investigated the subject will find it one of much interest, especially that portion relating to the metastasis of morbid cells, and their long period of hibernation.

The local treatment, consisting of moist dressings, antiseptic and deodorant, to protect the everted lids and cover the protruding mass; the care of the globe, which will be displaced sooner or later; and collapse from corneal ulcerations, for the disease does not attack the eye from without, is palliative. The free opening of the cornea, and eversion of the globe, will lessen the pain and nervous suffering. The in-

vasion of the brain cavity, and the facial and frontal sinuses, is attended by severe pain, and hypodermics of morphia must be resorted to for relief. The physical suffering attendant upon the progress of this disease is often considerable. I have seen cases, however, that were comparatively free from pain.

The *lachrymal gland* is subject to *cystic formations*, *simple hypertrophy*, and *malignant growths*; and *syphilis* in the form of a *gumma* frequently manifests itself as a slow-growing tumor in the orbital cavity, quite in contrast to the cancerous type, and occurs most frequently in the region of the lachrymal gland. The hypertrophied gland can usually be made out by noting its location and lobulated appearance; and a cyst by investigation with the aspirating needle.

Mr. L. H., aged forty-three, noticed, about four months ago, a small swelling to the temporal side of the eye. After the third month it was of sufficient size to displace the eye inward, and, during the last week, has not allowed the eye to close, the growth protruding through the opened lids. Palpation showed the tumor to be fluid and not attached to the globe. I shall now introduce into the dependent part of the tumor a large hypodermic needle, and aspirate. You see the fluid is clear and of the consistency of very thin mucus. (Fig. 25.)

The tumor is now collapsed and the eye returns to its place. The remains of the tumor can be felt in the region of the gland. The growth is evidently a cyst of the lachrymal gland. I shall now inject about 20 m. of a solution of iodine (1 of iodine, 1 of alcohol, and 4 of water), allowing it to remain ten minutes, and whatever is free to do so may flow out through the needle, taking care that none of it reaches the cornea. There will be a slight reaction and some pain, but the cyst will close up by adhesive inflammation.

The case now before us for examination, Mr. K., aged twenty-four, is in fair general health. There is a tumor about half an inch in diameter projecting into the conjunctival for-

nix, just below and to the temporal side of the lachrymal gland. It is firm, freely movable, and not tender to the touch. There is no evidence of involvement of the surrounding parts. The rate of development has been too rapid for a fatty, fibrinous, or cystic tumor, and too slow for the malignant type. It was first discovered about three weeks ago. The patient gives a history of syphilis in the third stage of the disease; primary sore, eruption, loss of hair, and copper-colored spots on the legs. There has been some intermittent medication.

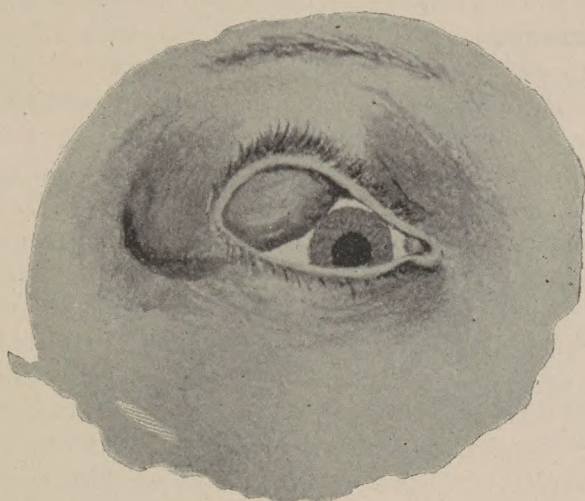


FIG. 25.

I shall advise potassium iodide, saturated solution, forty drops three times a day with elixir lactopeptin, gradually increasing the amount till sixty or eighty grains of the iodide are taken three times a day. To this we will add inunctions of mercury. If the tumor lessens in size it is a gumma; if it does not it must be promptly removed.

The case we have upon the table for operation is a girl child, two years of age, with *glioma of the retina*, and, from the exophthalmus, I am of the opinion that there is a growth

behind the eye. A glioma is a round-celled sarcoma and it springs from the neuroglia of the retina. Early enucleation sometimes saves the patient's life by preventing an extension of the disease to the optic nerve and thence to the orbit or brain. I shall proceed to the operation of enucleation with the idea that there are other growths behind the globe. On inspecting the pupillary space, you notice that it is occupied by a dirty-yellow tumor with a lobulated appearance and large blood vessels crossing the space. The tension of the eye is stony hard, the cornea lacks lustre, and there is a venous congestion of the globe.

Operation:

Separate conjunctiva from sclero-cornea, detach muscles, elevate the eye through the palpebral aperture and displace it to the nasal side, introduce the index finger to search for nodules about the optic nerve. Just back of the ball I find a large nodule about one-third the size of the eye; it springs from the lower part of the nerve close to the globe and extends to the upper temporal side. It so fills the cavity that I cannot pass behind it. I shall sever the nerve close to the globe, thoroughly drench the orbit with $\frac{1}{1000}$ corrosive chloride, separate the anterior layer of the orbital fascia, and clean out all contents of the orbit, cutting the nerve off at the apex of the orbit. Every scrap of tissue is cleaned away down to the periosteum. The cavity is washed with the zinc chloride solution twenty grains to the ounce, and then packed with iodoform gauze.

(Note.) Four years later. The wound healed quickly by granulation. The conjunctival cavity is of sufficient size to retain an artificial eye. There has been no return of the growth in the orbit or brain.

Pulsating tumors of the eye are rather infrequent in occurrence.

The case I present to you has been under personal observation for some years and has come to-day in response to

a card asking him as a favor to submit to our examination. This patient is a male, forty-two years of age. About eight years ago was struck on the forehead over the left eye by a heavy beam as it was being swung by a crane. He was unconscious for several hours and experienced the sensation of a slowly increasing pressure in the orbit soon after gaining consciousness. Blood had come from the nose and ears. There was a deposit of blood in the cavity of the tympanum and vertigo upon movement. The day following the accident he had two attacks of unconsciousness and became blind in the temporal field of the left eye. There was a slow infiltration of blood through the orbit and beneath the conjunctiva. When I saw the patient two weeks after the injury, vision had returned to the entire field; the blood had been absorbed until there was but little exophthalmus, but, to the nasal side of the eye, there was a soft, pulsating tumor pushing the eye toward the temporal side. He has, as a result, constant diplopia, the displaced object passing to the nasal side and above. There has been but little change in the tumor for seven years past. Vision in the eye is good. Pressure on the tumor gives a dull pulsation, which disappears by pressing upon the carotid artery, and, with it, the tumor becomes less, and the exophthalmus almost disappears. The only treatment that has been advised in this case has been the use of the elastic compression of the carotid artery. Without the clamp there is almost constant vertigo. The only operation worthy of consideration is the ligation of the common carotid. The failures and deaths from this operation are too great in number, however, to recommend it unless the urgent symptoms are more marked than in this case. Temperate living, moderation in exercise, and the use of the compress has made the patient comfortable for the past seven years.

Exophthalmus may result from paralysis of the recti muscles.

This woman is sixty-four years of age; about eighteen months ago she fell and bruised her eye; following which there was some discoloration and swelling. About five months ago she noticed that her vision was low, and that her eye did not move with freedom. The eye is now displaced downward and to the temporal side. Vision equals 20/200. There is no pain or tenderness; there is no movement in any direction except a little effort at abduction, though the eye is now fully turned out. Examination of the retina discloses nothing to explain the lowered vision, except that the veins are larger than the arteries as 4:1, the normal relation being 3:2. This condition would indicate an interruption of the blood return. When the lids are closed as fully as they can be, the eye seems to recede; a little pressure partially replaces it. Examination of the orbital cavity reveals nothing. My opinion is that there is a paralysis of the third nerve on this side, the result of a deep injury or fracture at the apex, and that there has been pressure made upon the return flow of blood, and that, on account of the laxness of the muscles, there has been some increase in the accumulation of orbital fat. We will try to keep the patient under observation for a time to note the changes which may occur.

Exophthalmic goitre, Grave's Disease, Basedow's Disease.

The patient which is present for our study to-day comes from the general medical clinic: she is twenty-two years of age. Family history bad, tuberculosis and insanity on the mother's side; tuberculosis and cancer on the father's side. (Fig. 26.)

At seventeen years of age she became anæmic and lost in weight and spirits. About four months later noticed a swelling of the thyroid gland with palpitation of the heart; pulse 160 to 180; drenching perspiration of hands and feet, excessive flushing of the face and neck. Insomnia followed.

and, later, excessive nervousness. About this time it was noticed that there was a protrusion of the eyes. The exophthalmus became rapidly more marked until now the lids can-

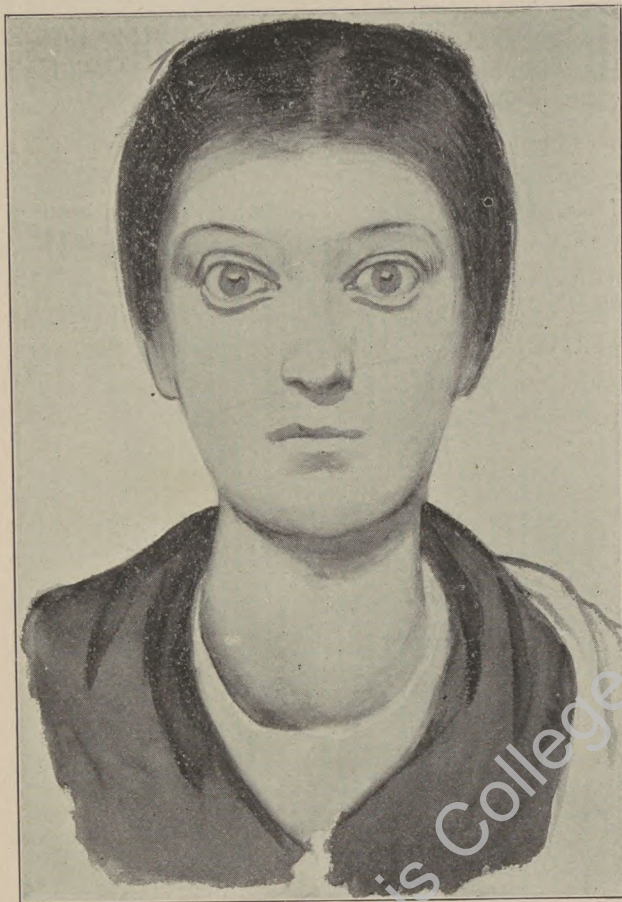


FIG. 26.

not cover the eyeballs to protect them from the dust and wind. She is referred to this clinic to see what can be done to protect the cornea from ulceration. I shall leave the treatment of the general condition to the department whence she

came.* We know almost nothing of the cause of this condition, and little more regarding its treatment and care.

To protect the cornea from threatened danger I shall operate. From the conjunctival surface of each lid I remove a strip of mucous membrane one-sixteenth of an inch in width, and extending from the external canthus one-fifth the distance toward the internal canthus, the strip being well inside the Meibomian glands. The freshened surfaces are held in apposition by sutures.

This procedure will permit free use of the eyes, protect the cornea and give a feeling of relief, for the patient is constantly conscious of the protrusion of the eyeball and the irritation of the conjunctiva and cornea.

Aside from careful feeding, absolute rest in bed, and the administration of tonics, there are only palliative measures to be used, unless the extract of thyroid, as prepared by Armour & Co., will prove of value.

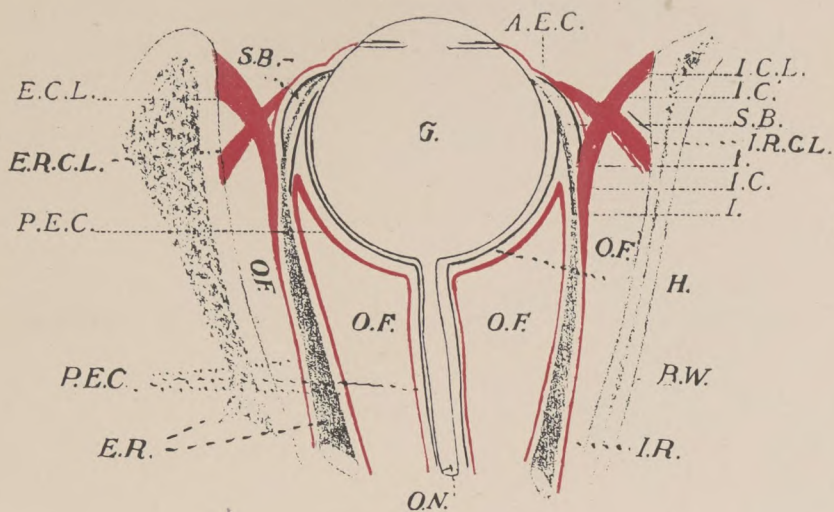


Fig. 1.



Fig. 2.

PLATE VI.

Fig. 2. Section of the orbit as seen from above (reduced).

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CHAPTER IV.

NON-PARALYTIC STRABISMUS.

Before taking up the topic of manifest or latent strabismus it will be to our advantage to go over the anatomy of the orbital cavity, with special attention to the eye muscles and their relation to the eyeball and check ligament. We should begin our study of this subject in the dead-house.

The first step will be to remove the lids covering the orbital cavity, and uncover the base of the aponeurotic cone. To do this we must carefully separate the conjunctiva from its substructure, the anterior layer of connective tissue derived from the capsule of Tenon. To make our work clear so that the location and relation of these structures may be better understood as we go on, I call your attention to this schematic drawing. You do not find upon the cadaver the structures so well marked as this drawing would indicate, but it will serve as a guide to our study. I have taken some of these drawings from a recent work on this subject: "*Maddox on the Ocular Muscles*," the best text-book treating upon tests and studies up to date. I have made some changes and additions to these sketches that they may better serve our purpose.

This drawing (Plate VI, Fig. 1), modified after Motais, shows the Globe (G.) suspended in the Capsule of Tenon (P. E. C.), together with the reflected portion which forms P. E. C.'. The Temporal Check Ligament (E. C. L.), the Nasal (I. C. L.) The anterior and posterior reflected por-

tions of the External Capsule (I. and I'). The Serous Bursa (S. B., S. B'). External and Internal Recti Muscles (E. R., I. R.). Reflection of the Internal Capsule on the tendon (I., I. C., I'). Optic Nerve (O. N.) Orbital fat and connective tissue (O. F.) External Retracting Check Ligament (E. R. C. L.) Internal Retracting Check Ligament (I. R. C. L.)

We can now go on with our dissection, noting the fact that we divide the structures, for the purpose of study, into two parts: First, the check ligament, which has to do with regulating the motion of the eyeball; second, the capsule of Tenon, the static or suspensory membrane.

After laying back the conjunctiva at the external canthus we observe the relation of the tendon to the globe; covering it there is a thin, almost homogeneous membrane extending from near the sclero-corneal junction back towards the temporal angle of the orbit (E. R. C. L.) Along the median line and covering the tendon this structure is denser than the portion extending from the superior and inferior orbital border to the globe, forming definite bands which become more dense as they approach the superior and inferior recti attachments, and form the check for the muscles, though not as heavy and well-formed as at the external and internal.

As these connective tissues pass forward onto the globe they become closely interwoven with the capsule of Tenon, and join in forming the annular ligament of the muscles. (Plate VIII, Fig. 1.) The deeper part of these bands can now be exposed by carefully passing a strong hook deep into the orbit along the wall, then sweeping it downward, behind, and to the wall side of the muscle; then bring the hook forward; a firm band is found connecting with the sheath of the internus and passing forward to the periosteum of the nasal fossa (E. C. L.). The band at the externus is as well-marked but not as heavy. Those of the superior and inferior are less well defined. These form an X-like interlacing of fibres, the orbito-muscular and the orbito-scleral bands. The five long

muscles which spring from about the optic foramen pass forward through the orbital fat, sheathed in reflections from the capsule of Tenon, and are attached to the globe by tendinous expansions. The sixth muscle, the inferior oblique, has its origin at the nasal side of the floor of the orbit, passes upward and toward the back of the eye to be attached just behind the equator below the horizontal meridian. The

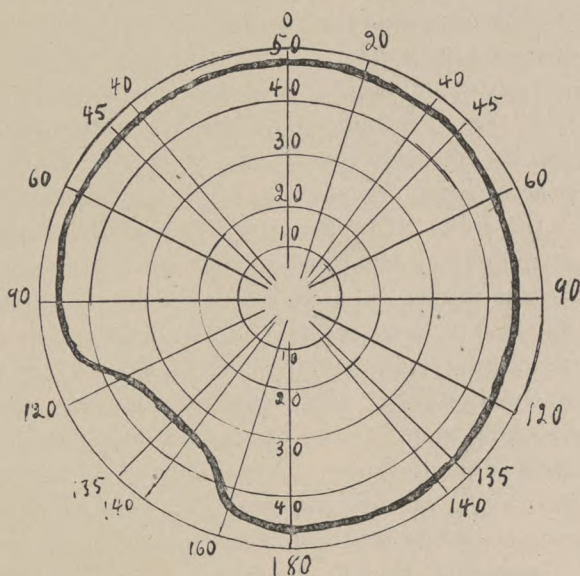


FIG. 27.
Normal field of fixation of right eye.

superior oblique passes through its loop of connective tissue, or pulley, at the roof of the orbit, and from there downward and outward to be attached to the globe just above the insertion of the inferior oblique. (Plate VI, Fig. 2). The four recti muscles as they pass forward embrace the globe, the central part of the tendon blending with the structures of the sclerotic, the lateral fibres thinning to form a broad expansion, interlacing with those on either side, as in Plate VIII, Fig. 1.

The internus is inserted near the sclero-corneal margin, 3 to 5 mm. distant from it, the external rectus from 5 to 7 mm., the superior just to the nasal side of the vertical meridian and 5 mm. back, the inferior about 4 mm. back from the cornea and 2 mm. to the nasal side of the vertical meridian.

There is great variation in the structure of these tendons both in thickness and in breadth. The check ligaments are difficult to define, in some cadavers it is not always possible to mark the beginning of the check fibres or follow them, but it is comparatively easy to define the group of fibres.

The new-born child has to acquire the habit of co-ordinate use of the eye muscles. The first attempts of the infant to fix its attention upon any object is accompanied by sundry irrelevant movements of the eyeball and much blinking of the lids. However, if there is nothing abnormal the eyes at the end of the third month are fairly accurate in their conjoined movements, and the macula lutea is in the center of fixation in both eyes. (Fig. 27.)

The function of the ocular muscles is to so direct the position of the eyes that the visual lines shall be projected toward the same point at the same time, and in that way secure binocular single vision. Any failure to do this will produce double vision, or diplopia, and the objective condition would be squint. The function of the orbito-muscular check ligament (Plate VII, D. Fig. 2) seems to be to regulate and steady the muscle to which it is attached, and of the orbito-scleral bands (Plate VII, B. Fig. 2) to restrain the action of the opposing muscle. This general statement does not take into account some of the actions of the oblique muscles. These tissues may be over or under developed, or become cicatricial and unyielding as the result of a traumatism or disease.

In treating of the subject in this short course of lectures I shall take the liberty to make some general statements, asking you to go over the text-books at your command for a fuller exposition. I do not deem it best to go into a discussion of points or theories not fully accepted. I shall only give you

my point of view and my conclusions, leaving you to well study the subject, if you have not already done so, and form an opinion for yourself. I shall not attempt to always give credit to those who have worked along these lines.

Strabismus may be due to faulty development of the recti muscles, errors of refraction and accommodation, abnormal development of the suspensory apparatus (Capsule of Tenon), the restraining of fibres and bands (check ligaments), or the innervation or enervation of the motor muscles. One or more of these causes may obtain at the same time. Faults in the media or retina may be exciting causes.

Double vision, the eyes seeing distinctly will result from misdirection of the eyes. The second image always moves in the opposite direction to the movement of the squinting eye. The farther from the fovea the second image is received the less distinct and confusing is the mental impression. The image in the habitually squinting eye is usually suppressed. Every movement is the result of coaction of all the motor muscles. When from any cause a muscle is stimulated to overaction the fellow-muscles must restrain or inhibit the movement; if they do not, some form of squint will take place and diplopia will result.

To recapitulate: The eye is suspended in the orbital cavity, and held in place by two classes of tissues.

1st. The dynamic—the recti, and oblique ocular and orbicular muscles.

2d. The static—the capsule of Tenon, the check ligament, orbital fat and orbital connective tissue.

The recti muscles together with the lids serve to hold the eye firmly against the supporting or suspensory structures, as well as to direct their movements. The capsule of Tenon serves as a socket in which the eye may rotate, and the orbital facias, (one division of which is the check ligament) connective and adipose tissue serving as a supporting, restraining bed in which it rests.

The relative positions of the two eyes may depend upon the bony structure of the orbit and the development of the orbital soft structures.

The relative or co-ordinate movements depend upon the neuro-muscular status of the dynamic system of the eye, and upon the modifying influence which the fascia exert, as they may be normal or abnormal in development.

The development of bony structures forming the boundaries of the base of the cavity of the orbit seems to modify the development of the orbital fascias and their relation to the eyeball, as in divergent squint and exophoria, when the plane of the outer canthus is far posterior to that of the inner canthus, or the base of the orbital cavity at a greater angle to the plane of the face.

Strabismus may be due to:

- 1st. Faulty or atypic bony development.
- 2nd. Faulty or atypic development of the soft structures.
- 3rd. Faulty or atypic development of the motor oculi muscles.
- 4th. Over or under stimulation of the motor centers of the recti muscles resulting from errors of refraction or imperfect co-ordinating impulse, and as a result, thickening and contraction of the fascias receiving their nutrition and innervation from a common source.
- 5th. Lowered visual acuity, or interference spots in the media. Or any or all of the above conditions combined.

Co-ordinate movements of the eyes may never have taken place, or having taken place, may, from some change in development or conditions, become periodically or permanently interrupted.

Orthotropia is the term applied to the normally balanced condition of the eye muscles.

Heterotropia, any form of manifest or objective error in co-ordination.

Esotropia, manifest convergent deviation.

Exotropia, manifest divergent deviation.

Hyperotropia, manifest upward deviation.

Primary esotropia is usually the result of imperfect evolution of the eyes, and, owing to the direct relation existing between accommodation and convergence, is most frequent in *hypermetropia* either simple or compound. *Exotropia* is usually the result of exhaustion or atrophy of the internal rectus. It occurs most frequently in uncorrected myopes of high degree, and frequently in hypermetropes after correction with glasses; it seems to be due in these latter cases to the excessive development of the external rectus from its overaction in inhibiting the internus to prevent esotropia. *Hyperotropia*, *subtropia*, are usually associated with eso- or exotropia. In functional squint the error lies between the two eyes. Amblyopia which occurs in strabismus may be congenital or acquired, and is never *per se* the cause of the squint.

To measure the displacement sit in front of the patient, cover the fixing eye and note the rotation of the squinting eye to the normal position. Place the strabismometer so that "O" comes under the center of the pupil, uncover the fellow eye and note the change of the pupil center and read the meter. This method will give approximately the amount of error in mm., or fractions of an inch. To obtain the measurement in degrees place the patient in front of a Landolt perimeter, direct the fixing eye to the center and carry a card along the arm of the instrument till the white reflex is located over the center of the pupil and read the degree marked opposite the card on the perimeter.

Secondary squint can best be estimated by covering the seeing eye and measuring its deviation with the strabismometer, the squinting eye fixing.

There are many ways of measuring and estimating the amount of deviation. For a full exposition of this subject I would refer you to Maddox or Landolt. The two methods which I have just briefly described are sufficient for most cases.

After estimating the degree of deviation the next step in

the study of the case will be to determine the cause of the error.

In squint due to errors of refraction the range of rotation in each eye tested separately will be normal. There will be no hesitation of movement when the patient is directed to follow the movements of an object passed over the field of fixation.

Where the error is due to muscle paralysis or structural defects the eye will hesitate, move with irregular, rotating, and jerking movements through its limited range. Its field of fixation will be abnormal.

The method which I frequently use in determining the mobility, is to cocaine the eye, and, with a pair of mouse-tooth forceps, grasp the conjunctiva, in a convergent squint, just to the corneal side of the insertion of the external rectus and rotate the eye out as far as it will go, and then grasp the internal rectus near its insertion and again rotate outward.

If there is in either case a slow, inelastic resistance we know that the eye is restrained in its movements by check ligament or connective tissue bands. If, on the other hand, the eye moves freely through its range it is evident that the squint is due to paralysis or to over-stimulation of the opposing muscle.

Prognosis:

In esotropia due to error of refraction with but slight difference in visual acuity, the patient not more than fifteen years of age, and wearing correction glasses, the prognosis is favorable to securing orthotropia without operation.

In esotropia due to error of refraction, and congenital or acquired contraction of the internal check ligaments and lengthening of the externi, the prognosis is good if there is partial tenotomy, severance of the restraining ligaments, and advancement of the externus. This is also true of hyperotropia.

In exotropia the error of refraction should be corrected and at once a graduated tenotomy made with section of the

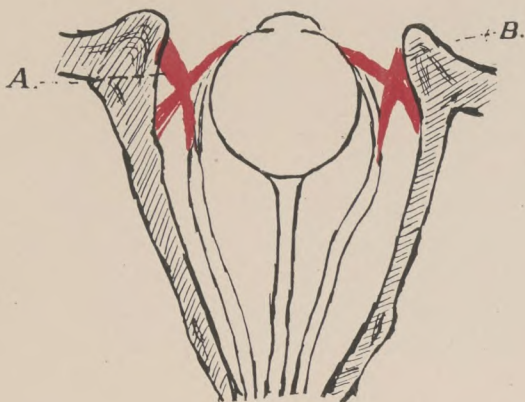


Fig. 1.

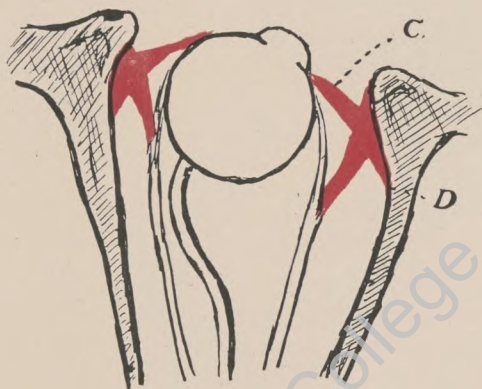


Fig. 2.

PLATE VII.

FIG. 1.—Schematic drawing, showing the crossing of check ligament fibres, eye at rest.

FIG. 2—Showing the eye in abduction.

C. External orbito-ocular check ligament.

D. External orbito-muscular check ligament.

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check ligament and, about three weeks later, an advancement of the opposing muscle done to complete the correction of the error. The prognosis is not so favorable, but good results can be obtained if the steps of the operation are taken with care, and the interval between the tenotomy and advancement is long enough to allow for the contraction and settling of the cicatrices. When the patient can arrange to give the time my rule is to do a double graduated tenotomy and ligation of the external recti; a month later advance the divergent eye to apparently a full correction; a month later, if there is still a divergence, correct the remaining error on the fixing eye, and as soon as the operation wounds will allow, institute systematic exercises.

In cases where one eye is amblyopic, or low in vision from any cause, the prognosis is favorable, providing all the steps are taken with care and deliberation.

I do not favor complete and unguarded tenotomy in any class of cases.

Exercise and training of the motor muscles of the eye, to be used both before the operation and afterward:

Exercise No. 1.—Cover the fixing eye and hold a small white disk in front of the patient at a distance of eighteen inches; direct the patient to follow it as you move it over his field of fixation, noting his range either on a perimeter or a large sheet of paper. Mark the center of the field and the extremes of rotation. The record should be made once a week, but the exercise should be taken twice a day. This training can be carried out either by the patient himself, if he is old enough, or by parents or nurse.

Exercise No. 2.—To be used after operation to restore consciousness of the second image and fusion of the two into binocular single vision. Place a light twenty feet distant from the patient, cover the eyes alternately with a dull black card or disk till the patient sees a light with one and then the other eye; then cover the squinting eye with a red-glass

cover and uncover leaving a longer interval each time till the patient is conscious of the red light, the white light, and then the two lights, one red and one white separately or fused, during the interval when both eyes are uncovered.

In some cases the fusion takes place quickly, and in others, even with much care and training, it takes place after a long time. In a few patients simultaneous double consciousness is never obtained even though there is apparent parallelism. In the operated cases Exercise No. 1 should be used as soon as the wounds have healed, and there is no tenderness.

Operation for the correction of non-paralytic strabismus. — Graduated tenotomy and ligotomy. — Operation on internal rectus.—After cocainizing the eye, place the speculum, pick up the conjunctiva over the insertion of the muscle to be operated with the strabismus scissors make a small vertical incision still holding the conjunctiva, direct the patient to look strongly to the temporal side, and, with the tenotomy hook feel the tension put upon the internal check ligament. If it seems to impede full rotation sever it in the direction indicated in Plate VIII, Fig. 1, A. To examine the under side of the tendon for tendo-ocular attachments or adventitious bands, pass the hook beneath the tendon and draw it forward to its ocular attachment or until the bands of connective tissue are met. Pass the hook around and draw them out far enough to sever. If the eye still fails of complete abduction pick up the tendon at its center just back of its attachment to the globe (Plate VIII, Fig. 1). A. make a vertical incision and extend the cut into the annular ligament A'.A'. This will allow the tendon to recede about 5 mm. To increase the effect of these operations close the vertical wound in the conjunctiva (Plate VIII, Fig. 3, S. S. A. B.) including in the suture the conjunctiva and anterior fold of the capsule of Tenon.

Advancement.—The incision is made as in tenotomy, the conjunctiva is dissected toward the conjunctival-scleral attach-

- A. A'. A'. Line of incision in
graduate tenotomy.
B. Exsection of tendon.
b. Excised portion of
tendon.
S. S. Sutures.
C. C. C. C. Annular ligament.

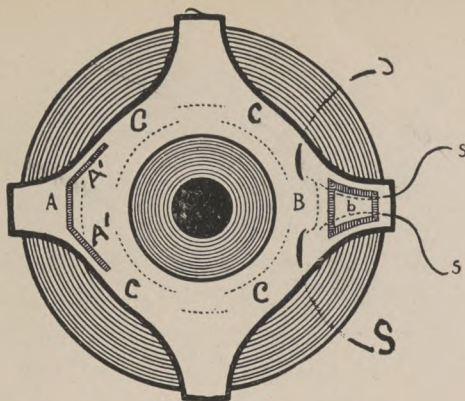


FIG. 1.

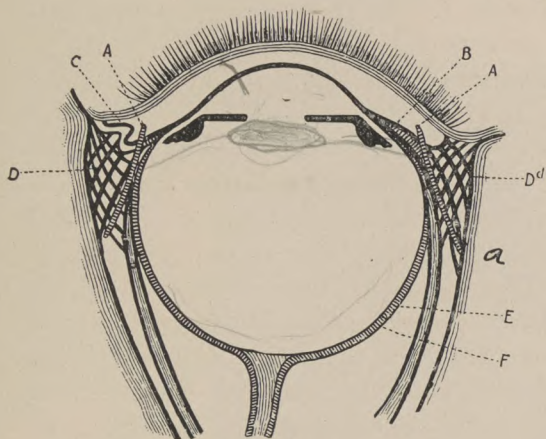


FIG. 1-

- A. A. Lines of incision.
B. Conjunctiva.
C. Plica Semilunaris.
D. Internal Check Liga-
ment.
Dd. External Check Liga-
ment.
E. Space.
F. Tenon's Capsule.

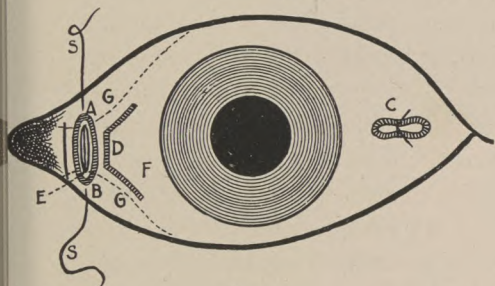


FIG. 3.

- A. { Incision through conjunctiva and
A. { check ligament.
C. Result of bringing A and B to-
gether with a suture. S. S.
D. Lines of cut in tendon.
E. Check Ligament.
F. Conjunctiva.
G. Expansion of tendon, internal
rectus.
S. S. Sutures in forcing stitch.

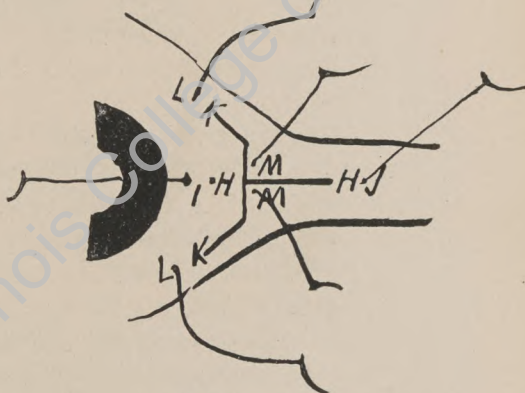


FIG. 4.

PLATE VIII.

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ment. Incise the tendon at its scleral attachment. (Plate VIII, Fig. 4, H. K. H.) Split the tendon as far back as it is desired to make the advancement (H.) Grasp the tendon at the right angle of the wound with catch-fixation forceps. Introduce double-armed suture at I. H., suture to the sclera at H. J., pass a double-armed suture through upper wing of tendon, M. L., and lower wing at M. L., and tie first I. J., then E.D., then M. and M.L.



FIG. 28.

To shorten the muscle by exsection, remove a quadrangular section of the tendon, as in Plate VIII, Fig. 1, B.b. Introduce sutures at S.S. Tie S.s. and S's.

The after-treatment consists in perfect rest of both eyes. under light bandage for several days. After a simple tenotomy no covering is desired, but it is best to flush the eyes frequently with a saturated solution of boric acid and to use protecting glasses. The correcting lenses should be worn constantly as soon as the eyes are freed from the bandages.

Esotropia, Convergent Squint, due to error of refraction.

This case, Master S., aged four years, had a high degree of convergence of the right eye. At two years of age the eyes were apparently normal. About three weeks after an attack of some infantile complaint the parents noticed a periodic convergence, coming on during excitement or fatigue.



FIG. 29.

The periods of convergence became more marked and lasted longer and longer until the condition became constant. We have tested his visual acuity and found that he could read 20/20, or that vision was normal. He was then atropinized and the refraction made with the following result: Compound hypermetropic astigmatism, O.D. +3.00 sp. +1.50 cy., ax. 90°; O.S. +3.00 sp. +1.00 cy., ax. 90°. Under atropine, solution one-half per cent., which we used continuously for two months, the esotropia has become less and less till now, at the

end of three months, the patient being the last month without the mydriatic, there is no squint (Fig. 28). We will now remove the glasses and note the result. The right eye at once converges about 4 mm. (Fig. 29). Replace the glasses and there is parallelism. This, then, is a case of functional squint corrected by the use of glasses, and without operation. The squint in this case was the result of the effort of accommodation to correct the error in refraction, and the accompanying

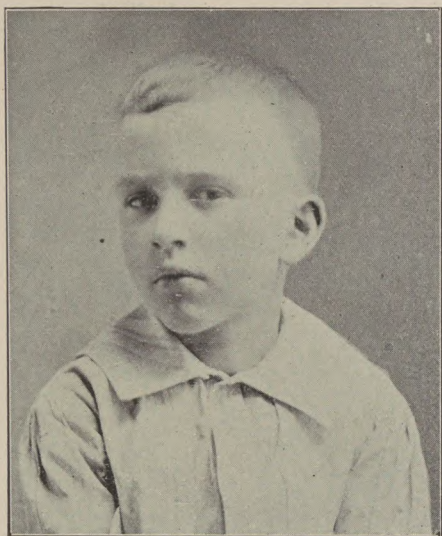


FIG. 30.

convergence stimulation which the external recti muscles refused to, or could not, inhibit. The result was convergence. Then to avoid the annoyance of lack of fusion, the convergence was still further increased, and cross-eyes resulted.

This photograph (Fig. 30) is from an old patient and will help to impress the importance of careful study of each case before operating for the cure of squint. This patient came with diplopia for all objects not in the line of fixation for which his head is posed as you see it in the photograph. In

other words, to secure binocular single vision, he was obliged to pose his head to the right. In all other positions he had double vision. His history is that at about four years of age he had periodic squint, which became constant during the following year. He consulted a physician, who advised and did a tenotomy on the left eye about one year ago. The eyes became apparently straight after the operation, but he began to suffer from headaches and pain in the eyes, and, in a short time, the left eye became divergent and diplopia became troublesome, until he found that by posing the head to the right side the diplopia disappeared, but not so the headache. Use of his eyes for schoolwork became impossible and he was referred to this clinic for examination. When we tested for abduction, we found that the movements of the eye were free and normal, but when tested for adduction the left eye, the one operated, could not be rotated to the extreme position, but lagged at about 3 mm.; the right moved through its full range. The patient, when observed from the median position, the head fixed and the examiner covering first one eye and then the other, showed a deviation outward, the right eye 5 mm., the left 7 mm. The head in the position shown in the photograph allowed binocular fixation and single vision. The headaches could not come from the exotropia for the divergence was too great to produce annoying diplopia for close work. The ophthalmoscope showed +2.00 or more dioptries of astigmatism in each eye, and some hypermetropia. Under atropia mydriasis the vision = $\frac{20}{100}$. We carefully refracted the patient ($V. = \frac{20}{20}$) and advanced the internal rectus of the left eye, and re-attached it to its former position, securing good rotation and but 4° of exophoria.

The point which I wish to make in introducing this case in connection with the patient before us is, to my mind, an important one: *That it is necessary, in all cases of convergent squint, to first use atropine and carefully refract the patient and allow time enough to lapse between refraction and study*

of the case to determine whether an operation is demanded to secure parallelism. For, in most cases of functional squint, it is possible to secure binocular single vision by careful refraction and training of the ocular muscles. The time required to do this will vary directly with the age of the patient and the acuity of his vision. This statement applies to patients under fifteen years of age, and to the early years of the squint. Though I have seen patients between twenty and thirty years of age acquire perfect orthophoria through wearing a correction, and submitting to training.

Congenital esotropia due to short internal sclero-orbital check ligaments; both eyes convergent. (I. R. C. L. of Plate VI, Fig. 1.) The head posed to either one side or the other, according to the eye used for fixation. This gives the person an eccentric posing of the head and is due to the inability to bring the eye used to the median line. Frequently such cases have low vision in one eye and use the best seeing eye for all directions. When both eyes are equally acute they can use one eye or the other at will, even these cases are right-eyed or left-eyed when attempting close work.

This little patient, Master K. (Fig. 31), is eight years of age, and has had convergent squint from infancy. He is right-eyed though he can see 20/60 with either eye. You will notice that the pose of the head is to the right and that the seeing eye never comes to the median line. We have kept the child under atropine mydriasis for about four weeks and during that time he has worn a full correction. O. D. and O. S. +4.50 sp. +1.50 cy., ax. 90°. Vision equals 20/30. There has been no improvement in the squint, but the headaches, due to the error of refraction, have ceased.

I shall now use cocaine, two drops of a five per cent. solution, in each eye until complete anæsthesia is produced, then try and determine the cause of convergence. The anæsthesia being complete, with a pair of fixation forceps

grasp the conjunctiva just over the insertion of the external rectus of the left eye, and try to rotate the eye outward. The eye can be forced about 1 mm. beyond the median line and there it meets with obstinate resistance at the internal canthus. The same manœuvre is attempted with the fellow eye with no better result. It seems that there is some inelastic resistance at the internal canthi which will not allow of free rotation; both the conjunctiva and the caruncle are drawn tense and elevated. A pledget of cotton saturated with



FIG. 31.

cocaine is placed over the internal canthus to increase the local anæsthesia, for the deeper parts in a child must be reached. I now make an incision over the right internal rectus about 3 mm. in length. Handing the fixation forceps to my assistant, I pass a Stevens' tenotomy hook back along the check ligament, I. R. C. L., and grasp the conjunctiva as before and attempt the rotation outward with the hook resting flat on the tendon and its ligament. I am enabled to feel the resistance offered by this band of tissue. Introducing the scissors,

I sever the band back about one-half to three-fourths of an inch, pass the hook up and down to see that the band is freely severed, place the hook beneath the tendon and draw it forward, feeling for adventitious attachments between the muscle and the ocular wall. We will, now that the check ligament is severed, attempt rotation of the eye outward, and find that it can move freely to the extreme position. The fellow eye is operated in the same way with like results. The tendons of the internal recti have not been severed, but the eyes are in the normal position by simply freeing the check ligament. The next step in the operation will be the closing of the conjunctival wound (see Plate VIII, Fig. 3, S. S.) This is done by introducing a suture into the conjunctiva at the angles of the incision, changing a vertical into a horizontal cut (C.), and in that way lengthening the conjunctiva between the caruncle and the cornea.

We are not through with the treatment of this case even though we have produced apparent parallelism. As soon as the wounds we have made have closed we must establish a system of ocular gymnastics and bring out the consciousness of binocular vision and co-ordination.

(Four weeks later.) This patient has been under observation every clinic day since the operation. For the benefit of those who have not watched our work I shall call attention to the notes made by the assistant in charge. Patient using glasses for full correction had apparent parallelism. Red glass over right eye gave at first no consciousness of a red flame; add prism 4° base down over left eye, no consciousness of diplopia. Covering one eye and then the other, saw two lights red and white; first sitting lasted ten minutes. Second sitting two days later, saw two lights part of the time. Third sitting, two lights and fusion without prism, with prism base down an esophoria of 8° . Atropine, which had been used up to this time, discontinued. A sitting ten days later gave fusion with red light over either eye. Vertical displacement, *i. e.* prism before left eye, base down, showed esophoria

ria of 4° . To-day we shall test the conjoined action which gives abduction equal to 22° , which gives a good ratio, the normal being 7 to 40.

This case, W. M. (Fig. 32), aged seven years, never had co-ordinate action of the ocular muscles. The right eye is turned strongly inward and upward; it does not attempt in any way to follow the movements of the left eye or to fix



FIG. 32.

when the left eye is covered; any attempt to turn the eye down or out is attended by jerking or nystagmus. The child has been refracted, the right eye being measured by the ophthalmoscope and the retinoscope to estimate its refraction, with the following result: Compound hypermetropic astigmatism $= +4.00$ sp. $+2.00$ cy. ax. 65° .

For some months we have been trying to train the eye to greater usefulness before attempting by operation to improve the cosmetic appearance of the child. There has been

great improvement in its acuity and control. As there seems to be an impediment to free rotation of the eye down or out with the forceps I have decided to shorten the inferior and the external rectus by an exsection of a portion of the tendon, as in operation for shortening, after a graduated tenotomy and ligotomy.

In order to secure a sufficient degree of effect a large quadrangle must be removed and an apparent over-effect secured.

As soon as the wounds have healed we shall also in this case attempt to improve the conditions by putting the eye through the manual of training. In cases where the patient is quite young much improvement of vision can be obtained by covering the good eye for an hour at a time once or twice daily and allowing the child to play about as best it can. I have records of cases where the vision has improved from 5/200 to 20/60 and were slowly gaining. Improvement should only be looked for where there is no evidence of disease or lack of development in the nerve of the retina, and where the eye is not unlike its fellow in development and refractive power. In order to obtain results one must have the aid of faithful, intelligent parents and assistants, for it means month after month of constant training with at first but little encouragement.

Esotropia with Hypermetropia and Amblyopia of one Eye.

—There are cases of squint with very low vision in one eye which are not improved by correcting glasses. The fellow eye, however, can be brought up to 20/20. The amblyopic eye is normal in appearance, but not in position.

This patient (Fig. 33), Mary K., is fourteen years of age, has had convergence of the right eye from early infancy. The child came to our clinic for the relief of headache about two months ago. She has been carefully refracted and has



FIG. 33.

Concomitant Strabismus. Primary squint of right eye.

worn her correction for about seven weeks with relief from headache. Vision, without atropine, gave, O. D.=5/200 O. S.=20/20 with +1.00 D. correction given. O. D. not improved by lenses. O. S.+1.50 sp.+0.50 cy. ax. 90. For about three weeks atropine sulphate one per cent. used twice daily without any apparent improvement of position of the squinting eye. Mydriasis was discontinued and with the resumption of the school work there was no return of the headache. She now comes to us to see what can be done to correct the squint. We will study the movement of the eyes.

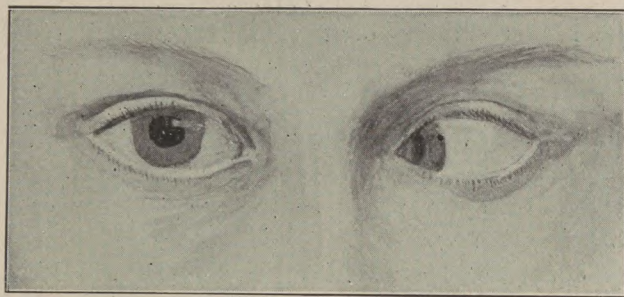


FIG. 34.

Same case as Fig. 33. Secondary squint. Left eye covered and squinting eye fixing. The effort of fixing with right eye causes the left eye to converge to a greater degree than the right eye did with the left eye fixing.

Right-eye converges to the extreme position; the left eye is in normal position. The inward rotation of the right eye is about 55° . Covering the left eye with the hand and requesting the patient to fix with the right there is a secondary squint of the left eye of 65° (Fig. 34). The abduction of the right eye is 15° , of the left 76° ; adduction normal in both eyes.

Test of mobility under cocaine by rotating with fixation forceps: left eye normal, right eye abducted to 30° . The resistance opposed to the abduction of the right eye seems to

be muscular as well as static, for there is a twitching and tremor which we only find in such cases.

I shall now open the conjunctiva over the internal rectus and examine the attachment of the tendon and the length of the internal check ligament. The tissues of these structures seem to be of unusual thickness and strength. A hook passed behind the ligament and next to the eyeball discovers *a thick band passing from the internal orbital wall forward, enclosing the muscle and passing on to the eye* about 3 mm. back of the attachment of the tendon and the globe allows of free rotation of the eye outward. I shall sever the check ligament as in Plate VIII, Fig. 2, and advance the external rectus muscle about 3 mm. (Operation described on page 66.) The eye is now held in normal position and moves freely with the fellow eye. Though at this time the voluntary external rotation is not as great as we hope it to be later, on account of tenderness from the recent cut. In a case of this kind with low vision in one eye the chances of perfect co-ordination are not as good as would be if the eyes were of equal visual acuity. There is no motive for eyes to act together and we must depend upon perfect muscular balance to accomplish apparent coaction. As soon as the tissues have become firmly fixed in their new relation and all tenderness and swelling has disappeared, we shall put the eye through a system of gymnastics to insure freedom of movement, and if necessary make further operative changes in order to secure and maintain good balance and apparent parallelism.

Eccentric pose of the head may be the result of squint and diplopia. To avoid the annoyance of the double vision the head is turned to favor the weak muscle, and is constantly carried in the unusual position.

This patient first came to me about one year ago; she was then six years old. In early childhood her parents noticed that she held her head to one side and tilted slightly

forward, that the mouth was held open and her speech was nervous and stammering when she fixed her attention on near objects. The effort to see also interfered with all her movements while at play. You will notice that she holds her head to the left with the chin dropped. In this position she sees but one light. With the red glass over either eye the red light appears to the right or left half of the doubled single flame. The red glass over the right eye, the head held in normal



FIG. 35.

position, the red light passes down and to the right side. The right eye, you will observe, is directed up and to the left. As soon as it is freed the head reverts to its habitual pose. "In double vision the eye always moves in opposite direction to the second object seen."

When she first came to me I corrected her error of refraction and kept her under atropine for some weeks, directing the mother to have the child go through the manual of abduction, adduction, and sursumduction for a few minutes

three or four times a day. This training has been kept up for about one year with good results so far as the mobility of the eyes is concerned, but there has been no improvement in the pose.

As the range of abduction and the fields of fixation are normal, I have advised advancement and shortening of the internal rectus of the right eye. We have estimated that a shortening of 3 mm. will be necessary to secure the correction desired. This we shall do.



FIG. 36.

The immediate result of the operation is a slight outward deviation of the right eye. We shall now cover the eyes with a bandage which will be removed every four hours and the eyes washed with a saturated solution of boric acid.

In connection with this case I present to you two photographs, Fig. 35, "*before*," and Fig. 36, "*after*," of a private patient who had the same form of error and has been treated in the same way.

In all squint cases it is important that the after-treatment should be kept in view. The prism exercise and the stereoscope should be employed; and later, if there seems to be a latent error, it should be corrected by the necessary operations.

This patient (Fig. 37), Miss S., aged twenty years, about three years ago was operated upon twice for the correction of squint, with apparent good results.* Our patient, however, complains of pain in the eyes and difficulty of maintaining single vision. The lids are flushed, and the margins covered by fine bran-like scales. Under atropine, error of refraction equals: $+1.00$ s., $+50$ cy., 90° in each eye; with correction V. equals $\frac{2}{3}$. The letters seem to move on the page and the words become mixed till the patient closes one eye to avoid confusion and secure single vision. Riding, driving, wheeling, or walking cause nausea and vertigo.

I find that, while there is at times a slight manifest esotropia, the range of abduction is limited and difficult, the head is thrown back and toward the left while reading.

The patient states that after the operation there was some inflammation and a purulent discharge, and that the wounds healed slowly. I presume that the wounds became septic and the protracted healing caused cicatricial bands to form in the check ligament. I shall open the conjunctiva, liberate it from the tendon, free the tendon from the attachments to the globe, as in graduated tenotomy, and shorten the external rectus as in the operation previously described, securing a deviation of about 4 mm. There is little danger of sepsis in these operations if care be taken to have clean instruments and if there is no acute catarrhal condition at the time of the operation. The normal tears and the lids are ample protec-

*I do not know the gentleman who operated; but, as he was not an ophthalmologist I presume that he viewed the condition of the eyes simply from a surgical standpoint, and did two complete tenotomies without first refracting the patient.

tion under ordinary conditions. In this case I shall apply the bandage to both eyes for twenty-four hours to insure quietness. As soon as the patient has recovered from the operation, abduction and adduction exercises should be instituted to insure mobility of the muscles.

Master F. is five years of age, he has been heterotropic for two years. When his mother first brought him to me for



FIG. 37

treatment I had him photographed. (Fig. 38.) You will notice that the right eye is strongly convergent. The eye moves freely over the field of fixation. The left is the fixing eye; its movements are also normal, but he almost closes it when he attempts to see letters and small objects. He has been under atropine for five days and the retinoscopic examination gives: +4.00 s., +1.50 cy., ax. 90° each eye, with vision about $\frac{20}{40}$. I shall advise the continued use of atropine and have the patient report in about one month.

(Note—Six weeks later.) Without the glasses the eyes, still under the mydriatic, are nearly normal in position (Fig. 39); with glasses correcting two-thirds of the error of refraction the eyes are normal in movement and position with single binocular vision.

This little patient is three years of age. During the past month the periodic squint (Fig. 40), which had become more



FIG. 38.

and more frequently recurrent, has become constant. She habitually poses the head toward the left, though the eyes are freely movable in all directions. She is now entering on the second stage of convergent squint due to error of refraction; she has hypermetropia $+3.50$ D. in both eyes. One week ago we began to use a one-half per cent. solution of atropia sulphate, two drops in each eye morning and night. To-day glasses will be given to be used as constantly as consistent with her age. She sees equally well with either eye. We

may hope that after two or three months' use of a one-fourth per cent. solution of atropine the eyes will become normal in position, and that the atropine may be discontinued. For the present the glasses need only be used indoors, and later in her kindergarten and school work, leaving her free from their encumbrance while out of doors at play.

In this connection I desire to protest against the perforated cardboard work expected of young children in the kin-



FIG. 39.

dergarten schools. To the few children who have fully-developed eyes it may do no harm, but the child with errors of refraction must suffer much strain and no little harm from such work. Every child should be carefully examined before entering even the lowest grades of school and errors of refraction corrected; the capacity for work estimated so that from the beginning they may be kept within their proper grade, both physical and mental. Care at this time would prevent many of the disastrous results of eye-strain, such as strabis-

mus, myopia, muscular asthenopia, and diseases of the inner tunics and structures of the eyes.

This case which I present to you to-day illustrates an uncommon type of development of the static and dynamic structures of the eye. This woman, aged twenty-eight, has limited movement of the eyes. Both eyes were in repose when



FIG. 40.

directed to the lower left field. The refraction is nearly normal. The range of fixation is now limited to about 20° as indicated in Fig. 41. Cocaine has been used. With the fixation forceps we find the rotation but little more extended. There is nothing in the history of the patient that would account for this condition. She has never had acute or chronic inflammation of the capsule of Tenon, or orbital cellulitis, or any disease of the eye muscles. So far as I can learn from her history and from photographs taken in childhood, the condition is congenital and due to atypic develop-

ment of the capsule of Tenon and the check ligament. The position in which you now see her eyes is the result of several operations, graduated tenotomies and advancements which I have done at various times during the past eight or ten years. (Fig. 42.) The results of our attempts at correction enable her to use her eyes in a straight-ahead position and to allow some

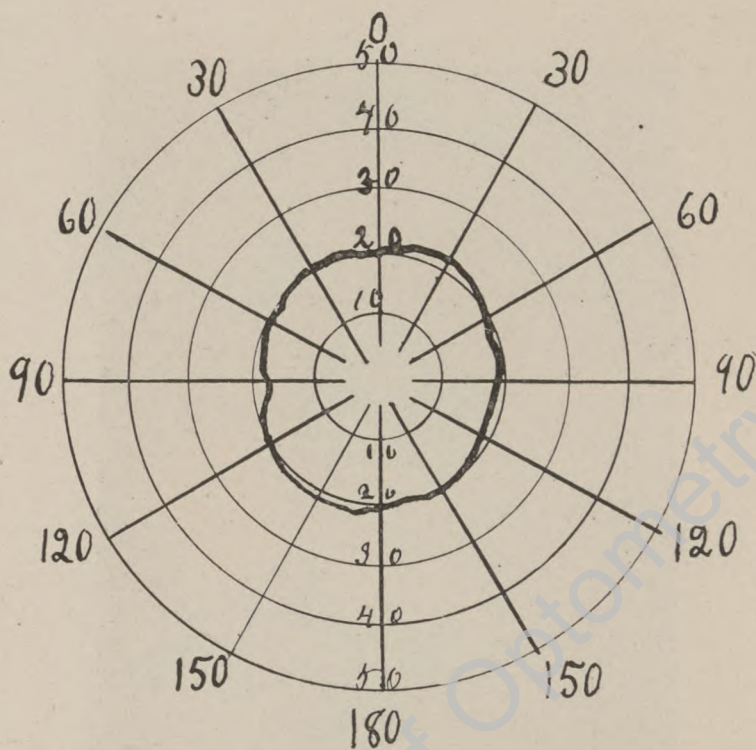


FIG. 41.
Present range of fixation.

freedom of movement without diplopia. The ocular tendons and ligaments were all abnormal in their development, the tendons bound to the globe by numerous adventitious bands from the check ligaments, these structures unusually thick and unyielding and not easily separated from the conjunctiva and globe.

We have at various times attempted to relieve the bound-up condition by repeated massage and stretching and by moving the eye forcibly about with fixation forceps, with but temporary good results.

The patient considers herself fortunate to be able to carry her head in the normal position. Her field of binocular fixation is limited only by the flexibility of the neck. With the head erect she has single binocular vision for about 15° in all directions, though the upper right field is forced. There are cases similar to this one with ptosis, narrowed lid aperture, and undeveloped globe.



FIG. 42.

Exotropia; divergent strabismus. — (Fig. 43.) This patient, Mr. S., aged thirty-one, in early life had convergent squint. At fourteen years he was operated upon to correct the convergence; the right internal rectus was completely tenotomized. His eyes were not examined at the time to determine their refraction, but he remembers that he could see the letters and drawings on the board at school as well as his mates and had no difficulty in determining distant objects. The year following the operation the right eye began to halt slightly and ultimately became divergent and almost immovable. The left eye began to be painful and caused him trouble

for two or three years resulting in myopia, his remote point being at sixty inches, or about one and one-half metre.

Examination with the ophthalmoscope shows a posterior staphyloma and the scars of an old choroiditis. The vitreous is cloudy and there are three festoons from the superior wall. Externally the sclerotic is thin and shows the uveal pigment toning it in two small areas.

As the result of choroiditis a myopia of high degree has developed. The divergent eye is much smaller than its fellow and is hypermetropic, $+3.00$ sph., $V. = \frac{2}{8} \frac{0}{0}$. It is quite probable that both eyes were originally hypermetropic, that the strain incident to the effort of correcting the error caused

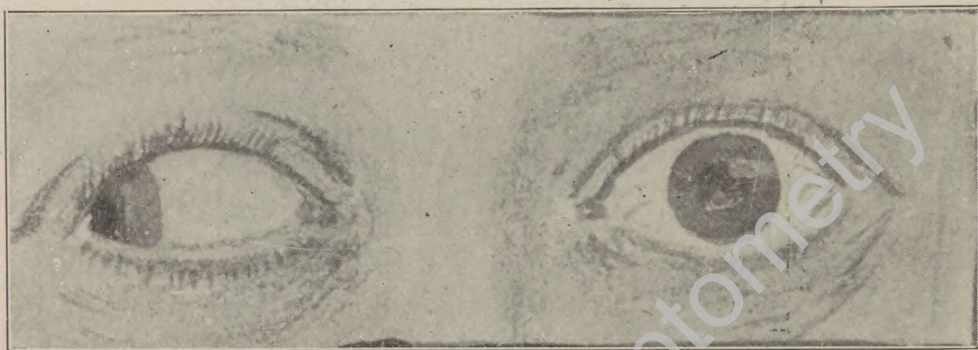


FIG. 43.

the choroiditis with the myopia as the sequel. To improve both his appearance and vision he presents himself for an operation to re-attach the tendon operated upon some years ago. The fixing eye with the correcting glass has vision equal to two-thirds. The divergent eye has vision equal to four-fifths and it will improve somewhat with use.

The importance of readjusting the squinting eye just at this time can hardly be estimated. In its present divergent position it has been of unconscious use to him, for while he uses his left eye for all close objects, he has unconsciously used the right for distant objects, and this is done by posing his head to favor the fixed position of the eye. He will depend upon it more and more if we are able to re-attach the

tendon and bring it into the normal position, for the visual acuity of the left eye is low and becoming less.

Operation:

Open the conjunctiva just over the normal attachment of the internal rectus. Dissect the membrane, freeing from its attachments to the globe; these attachments are due to the cicatrix of the former operation. With the hook search about for the tendon; not finding it attached to the globe, it must be held by the musculo-orbital bands of the check ligament. I now grasp these tissues with the forceps and direct the patient to rotate the eye from side to side. The sensation transmitted by the forceps is one of relaxation and contraction, the muscle is in the grasp of the instrument. I now introduce a barbed hook and catch the sheath of the muscle, draw it forward and grasp it with the fixation forceps, spread its tendon out flat, free it from the check ligament, and suture it to the sclera at its former attachment. I enclose in the superficial sutures only the conjunctiva, for I have found that the check ligament is liable to contract and impede the action of the muscle.

In addition to the advancement and re-attachment of the tendon I shall free the external rectus and check ligament, for the eye has been held so long in this position of complete abduction that the connective structures must be contracted and possibly adherent to the eye. I shall not, however, tenotomize the externus. After opening the conjunctiva I shall pass a hook beneath the check ligament, draw it forward and cut through its orbito-muscular band as in Plate VIII, Fig. 2, and with the strong fixation forceps grasp the tendon and stretch it, rotating the cornea into the canthus to its full extent. Then introduce a suture into the angles of the conjunctival wound and tie (Plate VIII, Fig. 3, A B). This will lengthen the conjunctiva to the extent of the length of the wound, which is about 4 mm. The eyes will be bandaged for five or six days, and kept quiet till the tenth day when the

sutures can be removed. It may be necessary to correct the position of the left eye at some future time.

This case illustrates the possible danger in all cases, when complete tenotomy is made, of *non-attachment of the severed tendon*, also the importance of an early refraction, for it is probable that a proper correction of the hypermetropia would have at least prevented the choroiditis, if it did not cure the squint.

Divergent squint may occur in myopia of high degree either with or without amblyopia as the result of under-ac-



FIG. 44.

commodation and over-convergence because of the error of refraction. For in myopia the accommodation is almost suspended and the convergence, on account of the closeness of the proximal point, is great. Fatigue of the adductors takes place and exhaustion is followed by divergence, first periodic, then constant. Or there may be atypic development of the structures of the orbit and suspensory ligament.

Mary A., aged nineteen years, presents herself for treatment. She has been refracted and we find that O. D. requires -12.00 sp., O. S.— 16.00 sp., V. = $\frac{2}{5}$. There is a posterior staphyloma and other evidences of progressive

myopia. The left eye is divergent, by the Landolt perimeter test, 48° . The eyes are prominent, the angle of the orbital base $= 30^{\circ}$, face narrow. The mother, whom the child resembles, is highly myopic though the eyes do not squint.

The young woman has never worn glasses and holds her book from four to six inches from the eyes. The parents first noticed the change in shape of her eyes at ten years of age; she had at that time intolerance of light, redness of the conjunctiva, and excessive lachrymation, and was confined to a dark room about three months, only going out of doors after sundown.

She comes desiring to have her eyes straightened. This I have declined to attempt on account of the extreme length



FIG. 45.

of the globe and the shallowness of the orbit. We could tenotomize the externus and advance the internus, but in my opinion it would be but a short time before the eye would relapse to its present position or become strongly convergent.

I present to you a photograph (Fig. 44) of a private patient in whom similar conditions exist. He had been tenotomized three years before he came to me, for the correction of a high degree of esotropia, and was given correcting glasses which he wore but a short time. After the operation there was still some convergence which gradually became less, then the eye became noticeably divergent until within a year following the operation it was strongly divergent. Three months following the operation the patient had two corneal ulcers from exposure of the eye, as the lids could no

shut closely enough to cover and protect the cornea. The irritation from the corneal disease caused still greater changes in the length of the eye until he was unable to bring the globe forward into its normal position. The conjunctiva from exposure to wind and dust was beefy and red and the eye painful. I advised enucleation as the best way to relieve the condition. The eye was removed, and two weeks later an artificial eye was fitted. Fig. 45 shows the extreme length of the eye and the shape resulting from the staphyloma.

This patient, Master L., is fourteen years of age; he became myopic, and periodically exotropic, at nine years of age, following an attack of scarlatina, at which time he was allowed to use his eyes almost continually looking at books and pictures and doing perforated cardboard work. Before that time he had been able to see as well as other children and did not have to be privileged in his school work. He has a progressive myopia of -8.00 D. in both eyes, $V. = \frac{20}{30}$. I shall advise a full correction of the error of refraction in a No. 4 tint, London smoke glasses; the use of atropine in the eye, one-half per cent. solution, two drops twice daily; life in the country; tonics; and that he abstain from all close work for three or four months. The divergence which is now periodic will not at present need attention, but as soon as the progressive disease has been checked, prism exercises and training must be instituted.

CHAPTER V.

PARALYSIS AND PARESIS OF THE OCULAR MUSCLES.

These conditions may result from brain disease or pressure upon the motor nerve supply of the eye occurring at any place from origin to distribution. When from any cause one or more of the eye muscles are enervated the opposing muscles divert the eye toward their line of action, the image seems to move in the opposite direction, and diplopia results.

Nervous supply of the eye and its appendages:

Cranial Nerves.	2nd.	Optic	{	Retina (<i>Sensation</i>)	
	3rd.	Motor Oculi	{	Recti Muscles	{ Superior Inferior (<i>motion</i>) Internal
				Inferior Oblique (<i>motion</i>)	
				Levator Palpebrarum Superioris (<i>motion</i>).	
				Iris, circular fibres (<i>motion</i>)	
	4th.	Patheticus	{	Superior Oblique (<i>motion</i>)	
	5th.	Trigeminus	{	Lachrymal, to gland	
Frontal (<i>motion</i>)					
Nasal				{ Ciliary Ganglion Long Ciliary { Ciliary Body Cornea Iris (<i>sensation</i>)	
6th.	Abducens	{	External Rectus (<i>motion</i>)		
7th.	Facial	{	Orbicularis (<i>motion</i>)		
Sympathetic	{	Iris Ciliary Body	{	(<i>motion</i>)

In order to avoid the confusion incident to double vision the patient poses his head in the opposite direction to the movement of the image, favoring the weak or paralyzed muscle and securing single binocular vision. *In the paralysis or paresis of an ocular muscle the head is turned toward the muscle affected.*

The superior oblique muscle turns the eye down and outward. The inferior oblique turns the eye up and outward. The superior rectus turns the eye up and inward. The inferior rectus turns the eye down and inward. The internal rectus turns the eye inward. The external rectus turns the eye outward.

When all the branches of the third nerve are involved the eye is directed outward by the external rectus and downward and outward by the superior oblique. The upper lid droops from paralysis of the levator palpebrarum superioris.

In paralysis of the superior rectus the eye is directed down and slightly outward. In paralysis of the inferior rectus the eye is directed up and slightly outward. In paralysis of the oblique muscles there is little or no change apparent in the position of the eye, and the subjective symptom is that of confusion of images which are nearly superimposed. The recti muscles and the opposing oblique act together in prevention of apparent change in position.

When all the motor oculi muscles are paralyzed the eyeball protrudes and there is exophthalmus with ptosis. This condition is called complete ophthalmoplegia.

In non-paralytic strabismus the squint comes on during the early years of life. *The field of fixation is normal*, or nearly so, except in cases where there are limiting bands of adhesion from cicatricial contraction, or from atypic development of the check ligament.

The eye may increase in its antero-posterior diameter from progressive myopia and become too long to be maintained in its normal position, and, as a result, it may lie across the

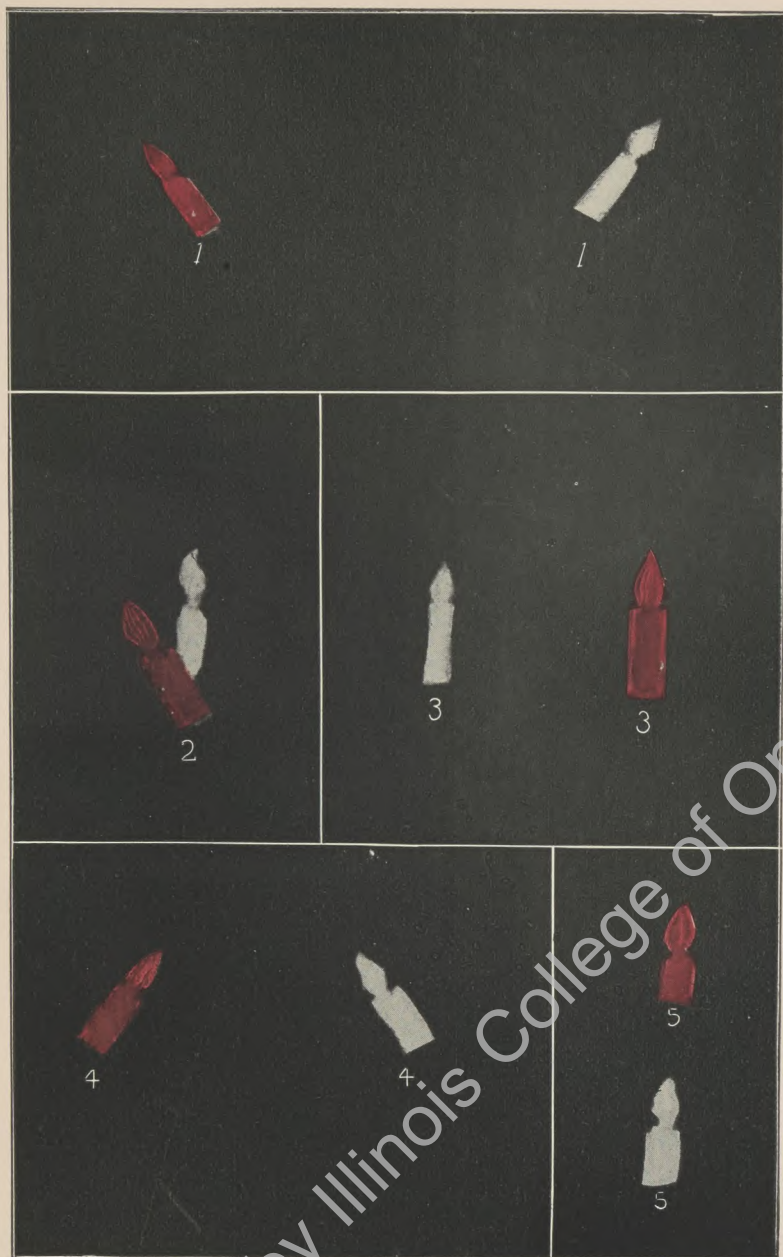


PLATE IX.

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base of the orbital cavity either in the convergent or divergent position.

In paralytic strabismus the mal-position of the eye may occur at any period of life with a *limited field of fixation* which cannot be accounted for by other causes than enervation; or there may be attending symptoms and history which point to the nervous origin of the error.

The tests for paralysis are both objective and subjective. The *objective test* is made by placing the patient in a good light directly in front of the observer and about three feet distant. Direct the patient to follow the movements of a small disk and tell you when it is seen double, the observer noting the movements and the point of arrest. Facing the patient toward a card with a field diagram on it the binocular field of fixation may be marked out, each eye also being separately measured. This test does well for all muscles except the oblique.

The *subjective test* is made with a heavy white line drawn upon a black surface. (Fig. 46.) Place the card in front of the patient, the line vertical, notice the position of the head when binocular single vision is secured, then direct him to allow you to control the movements of the head and note the position when the patient sees a double line, and if the lines are doubled whether they are parallel or crossing each other. With the red glass over one eye the line belonging to each eye can be distinguished.

The Light Test: Place the patient twenty feet from a candle or any small, steady light; cover the right eye with a ruby glass. If there is paralysis, a red and a white light will be seen.

Explanation of Plate IX:

Fig. 1: Paralysis of superior oblique and internal rectus.

Fig. 2: Paralysis of superior oblique.

Fig. 3: Paralysis of the external rectus.

Fig. 4: Paralysis of third nerve involving the internal rectus, inferior oblique, and inferior rectus.

Fig. 5: Paralysis of the right superior rectus.

Always keep in mind the general rule that the position of the second image of the object is always in the opposite direction to the deflection of the eye.

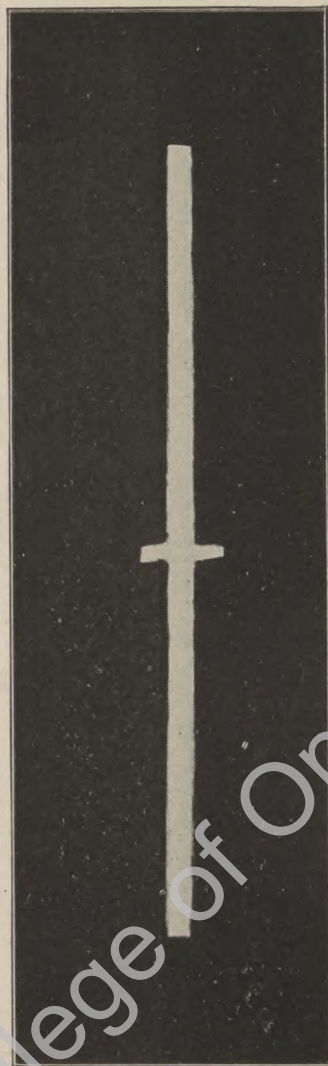


FIG. 46.

Causes of paralysis of the motor muscles of the eye.— Syphilis is one of the most common causes of diplopia; gum-mata may occur in any part of the optic tract and involve all of the ocular muscles; according to location they may cause single or double ophthalmoplegia, or involve only single muscles. Diplopia may occur in the early stage of locomotor

ataxia even before the other symptoms of the disease are present.

Paralysis of a group of muscles may follow scarlatina, diphtheria, pseudo-diphtheria, or any form of septic disease of the throat and nose. Fractures of the skull involving the apex of the orbit may be accompanied by partial or complete paralysis of the orbital muscles. Brain tumor, benign or malignant, or disease of the brain or spinal cord may also cause paralysis of the motor oculi nerves.

Prognosis is not favorable in tumors, fractures, or cicatricial pressure. In syphilis the chance for improvement varies inversely with the stage of the disease, and directly with the thoroughness of treatment. The diplopia and paralysis following acute infectious diseases usually disappears in the course of twenty to forty days, and leaves no after effects except in cases where hypermetropia exists and there has been a struggle between the recti muscles to maintain binocular single vision and correct the over-convergence impulse due to the effort of accommodation. In such cases the paralysis may pass away, but the squint, if it is convergent, remains.

This little patient, Mary S., aged twelve (Fig. 47), has esotropia which is quite manifest in all movements of the eyes. When she looks down and inward she has single vision. You will notice that in moving about the room she closes one eye, usually the left, and turns the head to the right. She walks with a staggering, uncertain gait, and closes both eyes most of the time when she is left to herself. About four weeks ago she, with other children in the same house, had an attack of malignant diphtheria. She is the only one of a family of five children who did not die in the early stage of the disease. She is not out of danger now, for the paralysis of the external recti and some of the throat muscles gives warning that one of the most dreaded of sequelæ is at hand and that other centers are in danger of invasion. There is no special treatment

to be given. It is best, however, to impress upon the parents the importance of rest for the eyes, not allowing the patient to read, write, or draw until the muscles have fully recovered their function. General treatment is to be continued and the elimination of toxins promoted.

Paralysis of the ocular muscles following an injury: Yesterday this woman, Mrs. A., thirty-eight years of age, was



FIG. 47.

Paralysis following diphtheria.

thrown from a cart and struck her head on the curbing. She was unconscious for a short time, otherwise not inconvenienced by the injury until during the afternoon, three or four hours after the accident, she noticed that objects were confused in outline, that she had difficulty in doing her work, and that she walked with a staggering, uncertain gait. She comes to-day for examination and advice.

There is a contused wound just to the temporal side of the right eyebrow, the swelling is considerable, and the extra-

vasated blood discolors the conjunctiva and, by absorption, the iris and anterior chamber. The iris is not ruptured, the lens is not dislocated, the fundus is normal. The movements of the eyes are impaired but not limited in any particular direction; there is no apparent heterotropia. The eye is just noticeably exophthalmic. She does not give a history of nasal hæmorrhage. She complains of flashes of light and the subjective sensation of color light balls when in a darkened room. On examination of the ear the cavity of the tympanum is found to be full of blood; the hearing is reduced to watch on contact. We have a case of fracture through the base of the skull, just how extensive or serious we can only tell by awaiting the developments of the case. I shall place her in the hospital, keep her quiet in bed and present her to you at a later date.

(Four days later.) You notice that the left eye is strongly divergent, that there is some ptosis, and the exophthalmus is greater from intra-orbital hæmorrhage.

She has had almost constant vertigo, and is not allowed to change her position in bed. The ophthalmoscope shows slight choking of the disk. She sleeps well, and complains of but little pain. We will continue the rest in bed, light diet, potassium iodide, and laxatives.

(Two weeks later.) The history of the past two weeks has been one of gradual improvement, confusion of vision alone remaining. Placing our patient twenty feet from a dim light she distinguishes but one light; but a red glass placed before the injured eye gives two lights, one red and one white, the red light crossing the white at an angle of 145° . For a proximal test we will use the vertical line. The second image is now seen crossing the normal at an angle of 145° from the vertical. (Plate IX, Fig. 2.) The eye is rotated outward, the superior oblique is paralyzed, and the inferior oblique is without restraint.

The prognosis is not good so far as the paralysis is concerned. My experience with fractures through the apex of the

orbit is not favorable to recovery, especially when the patheticus is involved.

The treatment I shall prescribe consists of ocular massage, the stretching and stimulating of the muscles by grasping the externus at its attachment and forcing the eye through full range of abduction and adduction to keep up the muscle tone until the function is restored.

Paralysis of the right externus in syphilis.—This patient, aged twenty-eight years, contracted syphilis about three years ago, was under treatment for a time and discontinued it.



FIG. 48.

Paralysis of the right inferior rectus in a man twenty-eight years of age. Patient had initial lesion of syphilis two years ago. Left leg and left hand partly paralyzed. General anæsthesia. Referred from Prof. Belfield's clinic.

A sharp attack of iritis caused him to seek medical advice. As soon as the eye was well he again discontinued treatment. He now comes complaining of double vision. The objective test gives limited abduction of the right eye (Fig. 49), the head, in order to prevent confusion from double images, is turned toward the right. (See subjective test. Plate IX, Fig. 3. Place the patient twenty feet from the test light, cover the right eye with a ruby glass, the red light is to the right of the white one.) This patient will be placed under treatment; hydrarg. oleate rubbed into the axilla or groin, potassium iodide, forty to one hundred and twenty grains

daily, and organic iron. I shall also advise the use of hot baths three times a week, with a cool morning sponge or hand bath. These cases usually respond quickly to treatment. If this one does not, and the diplopia is confusing, an advancement can be made including the tendon of the externus and the check ligament.

This patient, Mr. L., aged twenty-seven, is referred from the clinic for nervous diseases. The diagnosis, locomotor

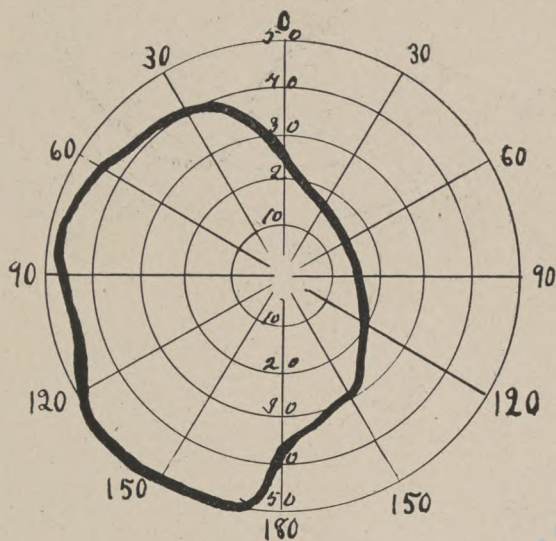
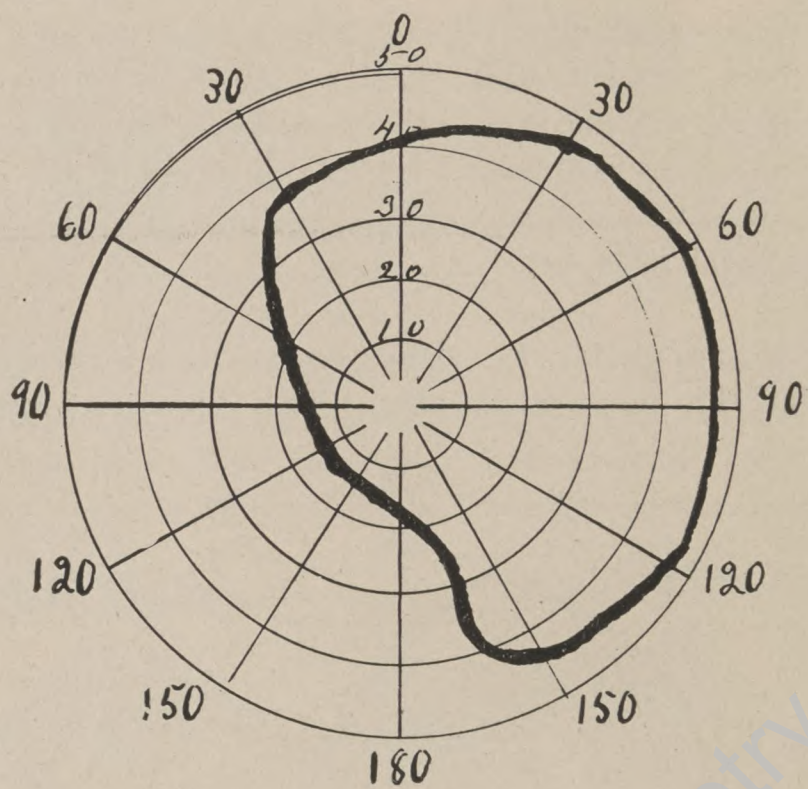
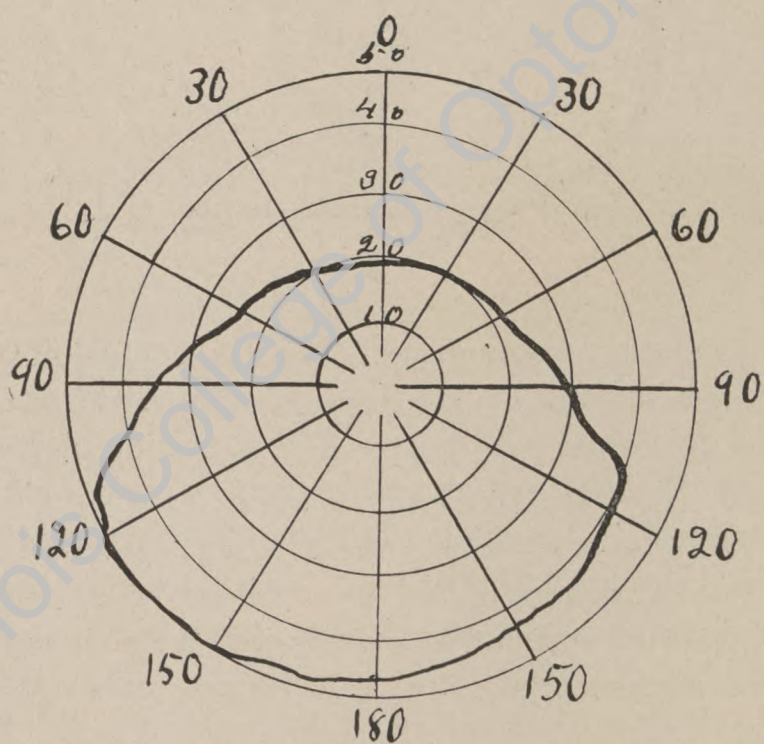


FIG. 49.

ataxia, has already been made. He has confusion of vision. The red glass in front of the right eye shows the red light to the left of the white and below it. A tracing of his field of fixation limits right eye to the lower temporal field, left to upper temporal. (Fig. 50.) The pupil is contracted and does not respond to light stimulation. The optic nerve and retina are not noticeably changed. Vision is just below normal, $\frac{2}{3}$. He has diplopia in all parts of his field of fixation except the central. He has paralysis of all of the motor oculi branches of the third nerve, and binocular divergence with rotation.



Left eye.



Right eye

FIG. 50.

This case presents some uncommon eye symptoms. The visual acuity is unusually high for the stage of the disease in which the other symptoms would seem to place the patient. The paralysis of the ocular muscles is occurring for the second

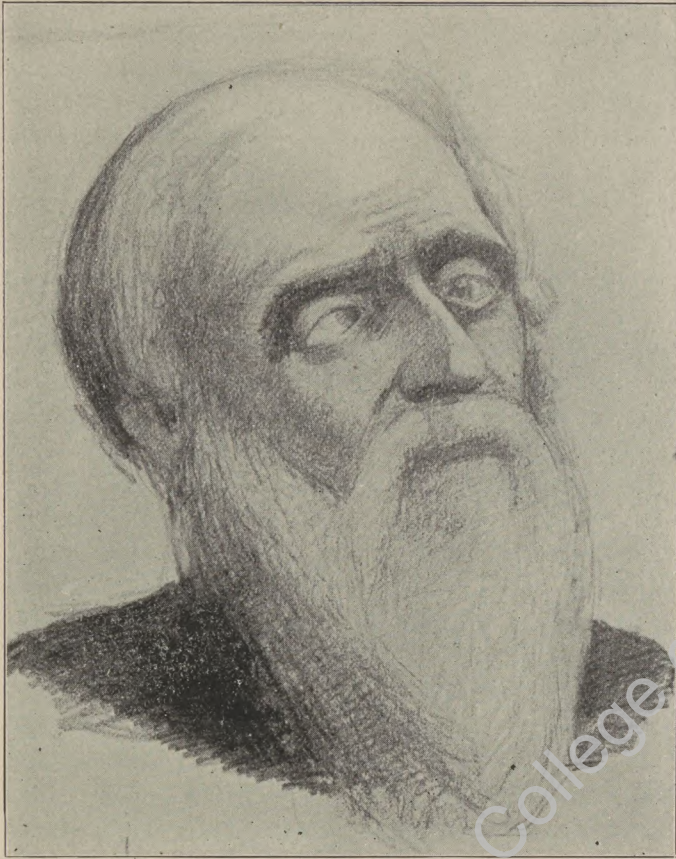


FIG. 51.

time, for two years ago he had an attack and fully recovered. The pupil does not respond to a mydriatic, which is very unusual in my experience.

Paralysis of both external recti muscles.—This old man presents himself for examination. (Fig. 51.) He complains of

confusion of vision, and the red glass gives double image, the red to the right; the eyes convergent = 45° . There is no history except of rheumatism to explain the condition. You will notice that he poses the head backward, and to the right or left as he may desire to direct his gaze. Forcing his head into the erect position he is not able to walk about or locate objects accurately. This condition has been slowly increasing for some weeks. We have given him prisms as long as they were of any use, and now have covered one eye. He was referred to our colleagues for general treatment and advice, but the paralysis of the externi is increasing until now it is almost complete. There is no other evidence of disease of the brain or spinal cord, and no history of injury. The only clew to the possible cause lies in the fact that he has chalky radial arteries and rheumatic arthritis. There may be central changes going on which later may extend to the other nuclei and explain the location of the lesion. I shall not advise operation at this stage of the disease, but again refer him to the general medicine clinic for further treatment.

Nystagmus is characterized by short, rapid, rhythmic, oscillations or rotations of the eyes. It occurs, in order of frequency, in albinos, amblyopes, epileptics, and people whose occupation requires them to work for long hours in unusual positions, as in coal mines and in boiler-making and riveting.

Nystagmus may be congenital, acquired, or occupational. Persons afflicted with congenital nystagmus occurring in conjunction with vision which is normally fair but for the spasm of the recti muscles, or which can by the aid of proper correction lenses be raised to fair vision, may be greatly improved in personal appearance, and the nystagmatic movements lessened or totally suspended, by relieving the abnormal relation existing between the motor muscles and the eyes themselves, or between them and the soft or the bony structures in which they are suspended. In a limited number of cases the correction of the errors of refraction, which have

usually been high, has been sufficient to do away with the tremulous or oscillating movement.

These two children are totally color-blind and nystagmatic. The elder, a girl of fourteen, is very clever at sorting worsteds as to value, but totally unable to determine their color. The brother, twelve years of age, cannot sort colors and is less accurate in arranging them in values. They have no errors of refraction, and their vision is about $\frac{2}{40}$ in good light.

Their mother stated that they were noticed to have unsteady eyes soon after birth, and had had no illness except the usual attacks of colds and indigestion of childhood. They were blondes but not albinos, strong, bright and healthy. The mother has taken them to several physicians, seeking relief for the nystagmus. The prognosis has been so uniformly unfavorable that she had long ago despaired of giving them relief, and they are now consulting me for a slight conjunctivitis. The children did not know that they were color-blind, and I discovered it by accident.

These cases call to mind the papers by Oglesby, and the criticisms of his conclusions by Snell. The observations made by Snell on miners suffering from occupation-nystagmus, led him to the conclusion that acquired nystagmus was due, among miners and others, to the awkward and unusual position in which they were forced to place themselves while at work and the long-sustained and unaccustomed position of their eyes during their shifts of labor, and not to functional or organic diseases of the brain.

In my observations in cases of squint due to contracted or undeveloped check ligament, and the nystagmatic movements which attend the effort to overcome the inhibition of the ligament, their regular movement has been the greatest at the extreme limit of forced abduction or adduction and the eyes have been at rest, or nearly so, when favoring the contracted

fascia. In watching congenital nystagmatic patients, it has been noticed that there is one position that their eyes assume which affords them improved vision and obtains comparative quiet. In all other positions the eyes move with greater rapidity, and longer and more irregular excursions. And in the extreme opposite position, the visual lines are widely removed from their habitual relation, and give the sensation of confusing diplopia and a greater blurring of vision.

It occurred to me that I might at least be able to bring the position of rest to the median line, correct the eccentric pose of the head, and, possibly, relieve the oscillating movements throughout the entire range. This I endeavored to accomplish, first studying the head and eye movements in all acts of seeing, determining their position of complete rest and acutest vision. Then studying the range of adduction, abduction, and sursumduction, and, if present, rotation. This was done with eyes used singly and together.

The girl, Maggie C., nystagmatic from birth, with head posed to the left and eyes directed to the right, vision = $\frac{2}{4} \frac{0}{0}$; head erect and eyes directed in front, vision = $\frac{2}{2} \frac{0}{0}$; head to the right and eyes directed to the left, could not determine that there were letters on the chart.

Left eye covered, right eye exposed, easy and complete abduction. At point of complete abduction, the eye makes slow and periodic excursions over a small area, at times the eye remains perfectly quiet. In adduction the rotation is large and rapid, the up-and-down movements are hesitatingly made.

Right eye covered, left eye exposed, rotation in the whole range more irregular and spasmodic than the right; the point of greatest quiet at complete adduction. Abduction can be made only to two-thirds of normal range.

With the object in view, to change the point of fixation and rest to the median line, and, possibly, by making this change arrest the spasm, we have determined to tenotomize

the external rectus of the right eye, and the internal rectus of the left.

(Two weeks later.) We operated with but slight results. The rotation was less, and the point of rest was changed to twenty-five or thirty degrees to the right of the median line. Advancement of the right internal rectus, and of the left external rectus was made and the point of rest was carried to the left of the median line about ten degrees. In this position the eyes were very quiet, but the habit of posing the head to the left was difficult to correct, and proved to be too great a strain upon the sutures of the left eye, for we had to introduce firmer ones the next day.

To-day the eyes are as quiet in their new position as they had been in their former position of rest. Vision is good and the habit of posturing the head has been overcome, and the purpose of the operation, in part, has been obtained.

(The brother then submitted himself to the same study and treatment, with similar results.)

Mary O., aged seventeen years; irregular motion of the eyes first noticed in early childhood. The parents claim that the movements were slight at first, but increased as the child moved about, and that in trying to use the eyes she made violent movements; also was excited on going into strong light. At an early age they noticed that the child's head was turned to the right and bent forward; she was not able to run about and play as freely as the other children. In reading she held the book close to the face and moved the head in following the lines; movements of the hands accompanying close vision were slow and abnormally deliberate; complained of headache and "bad spells," which I should call *petit mal*, once in four or ten weeks. These attacks had been more frequent during the past year. Just before the spells she had a buzzing sound in the ears and a flash of light before the eyes. These attacks occurred in the afternoon, and usually followed close application. Severe headaches followed the

flash of light, when there was a lapse of memory and moments of forgetfulness. When the full-fledged spell occurred she would be dull and listless for hours.

Examination: Nystagmus oscillating point of rest, extreme left abduction, with head forward and eyebrows elevated. Vision in right eye $= \frac{2}{8} \frac{0}{0}$; in left eye $= \frac{2}{4} \frac{0}{0}$. Head erect and eyes directed forward, vision $= \frac{2}{2} \frac{0}{0}$. The left eye cannot be brought to the median line without covering the right.

Refraction: Compound hypermetropic astigmatism. R. $= +1.75$ sph. $+2.00$ cy., ax. 180° . V. $= \frac{2}{4} \frac{0}{0}$. L. $= +2.50$ sph., $+3.00$ cy., ax. 180° . The estimation of the refraction is unusually difficult. Glasses are given with the full correction and placed so that the patient can hold the head in the position of easiest vision.

(Later.) Headache, *petit mal*, and indigestion were at once relieved. The eye movements did not change, and the asthenopia is less.

(The year following.) We operated to correct the hyperphoria and, later, the posing of the head to the side. Besides the tenotomy of the left superior, an advancement of the right inferior rectus was made. Before perfect front placement was obtained tenotomies of the right internus and of the left externus were made.

(Later.) Advancement of the right externus gave front placement and rest with but slight tremor in any part of the range. Vertical displacement gave but slight unsteadiness of the eyes, and alternating heterophoria.

The result was better than I expected so far as the nystagmus was concerned, but the experience of the first two cases made me confident regarding the ability to change the position of rest.

John Mc. C., oscillating nystagmus, fixation and point of rest at left abduction; right eye did not follow; vision of left eye $\frac{2}{8} \frac{0}{0}$, improved to $\frac{2}{3} \frac{0}{0}$, with $+1.50$ cy., ax. 90° . We operated to secure central fixation, with good results so far as

the left eye was concerned, but the right eye soon relapsed into its old independent position, and was not again interfered with. The glasses in this case were made up of two layers of glass, and corrected the astigmatism, and covered with a perforated disk of dark "London smoke" glass which acted as a diaphragm excluding all side light. This device prolonged his ability to work in a strong light. The patient was a draughtsman.

The following are deductions from my experience in treating nystagmus:

First, congenital nystagmus may be due to amblyopia from any cause, or from ametropia.

Second, congenital nystagmus may occur in atypic development of the eye and its appendages, and be due wholly or in part to the exhaustion or irritation of the motor oculi muscles or their nerve centers in their attempt to co-ordinate with the other acts of vision.

Third, in treating cases due to amblyopia from errors of refraction, the correction of the errors may lessen or completely cure the spasm.

Fourth, those cases which are due to amblyopia from other causes than errors of refraction, may be relieved directly as the cause of the amblyopia can be removed.

Fifth, the causes which are due to atypic development of the eyes or their appendages, may be relieved so far as we are able to properly establish them in normal relation to each other and their surroundings.

The remedies of service in my hands have been, first, carefully correcting errors of refraction and the placing of the correcting glasses in the position to secure the best vision. Second, training the eyes to perform their ranges of rotation with the head fixed. Third, operations upon the recti muscles to secure full abduction, adduction and *central fixation with eyes at point of greatest rest.*

CHAPTER VI

HETEROPHORIA; LATENT SQUINT; AND MUSCULAR ASTHENOPIA. FUNCTIONAL NERVOUS DISEASES.

The study of the subject of heterophoria, or latent squint, naturally follows the preceding topic, heterotropia or manifest squint; and the work already done in dissecting the orbital muscles, tendons and ligaments makes us familiar with the anatomy of these structures and their relation to each other.

We will find it to our advantage to very briefly review the subject of binocular fixation, the physiology of binocular single vision, and the optics of prisms and their application to the diagnosis and treatment of heterophoria.

Dr. George T. Stevens, a pioneer in this field of work, has given us the essentials of this subject, to which there has been nothing of importance added. He has also given us a most convenient nomenclature:

“The different relations of the visual lines which may now be found may be defined and arranged as follows, a state of the most complete relaxation of the muscular effort attainable being always supposed:

“I. Generic Terms.—Orthophoria: A tending of the visual lines in parallelism. Heterophoria: A tending of these lines in some other way.

“II. Specific Terms.—Heterophoria may be divided into:

“1. Esophoria: A tending of the visual lines inward.

“2. Exophoria: A tending of the lines outward.

Right Field. Left Field. Right Field. Left Field.

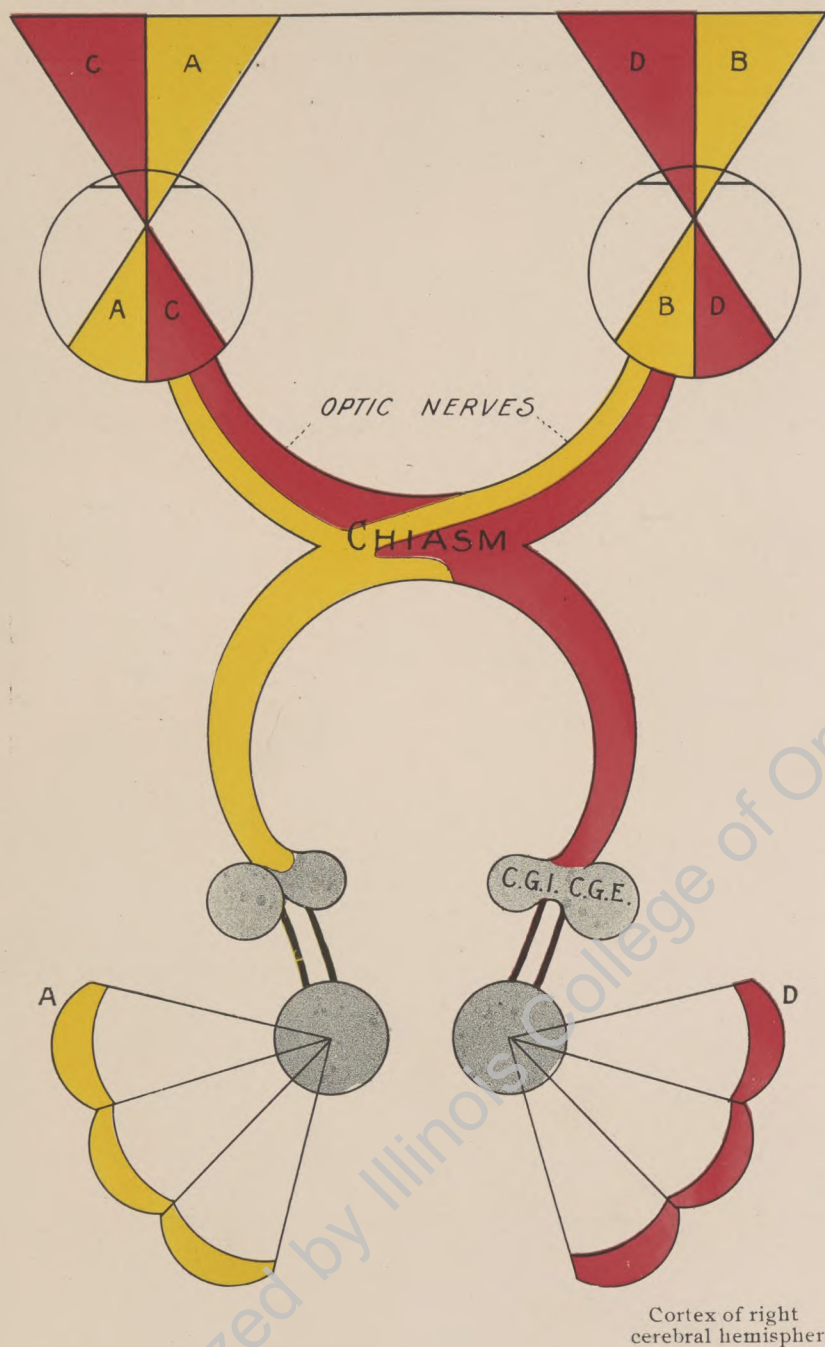


PLATE X.

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“ 3. Hyperphoria (right and left): A tending of the right or left visual line in a direction above its fellow.

“ This term does not imply that the line to which it is referred is too high, but that it is higher than the other, without indicating which may be at fault.

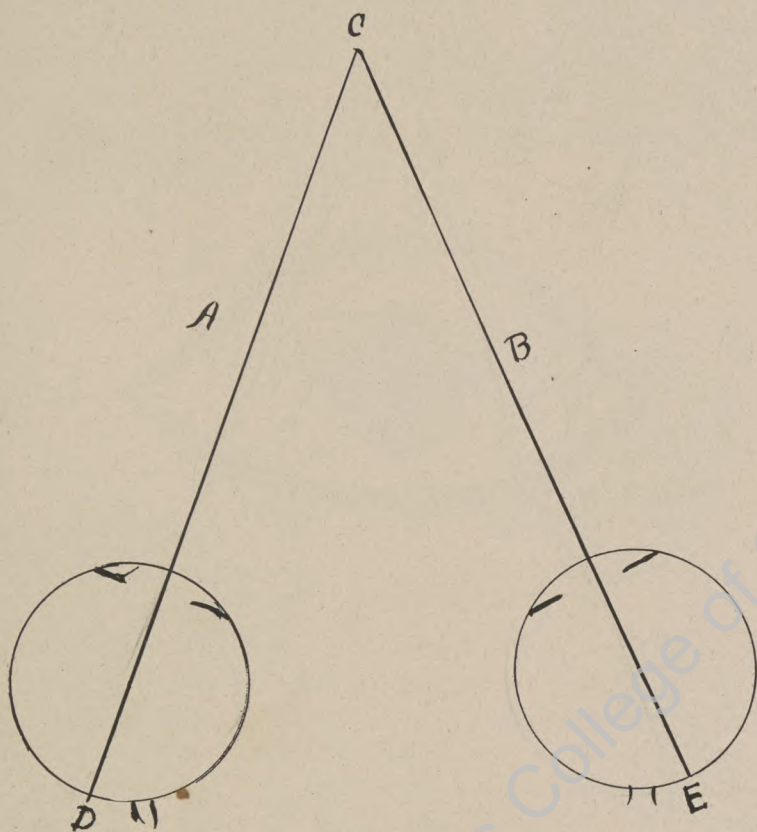


FIG. 52.

“ Anophoria: A tendency to deviate, on the part of both visual lines, above the most favorable plane for passive adjustment.

“ Katoporia: A tendency of both visual lines below the most favorable plane for passive adjustment.

“ III. Compound Terms.—Tendencies in an oblique direction may be expressed as hyperesophoria, a tending upward and inward, or hyperexophoria, a tending upward and outward. The designation ‘right’ or ‘left’ must be applied in these terms.

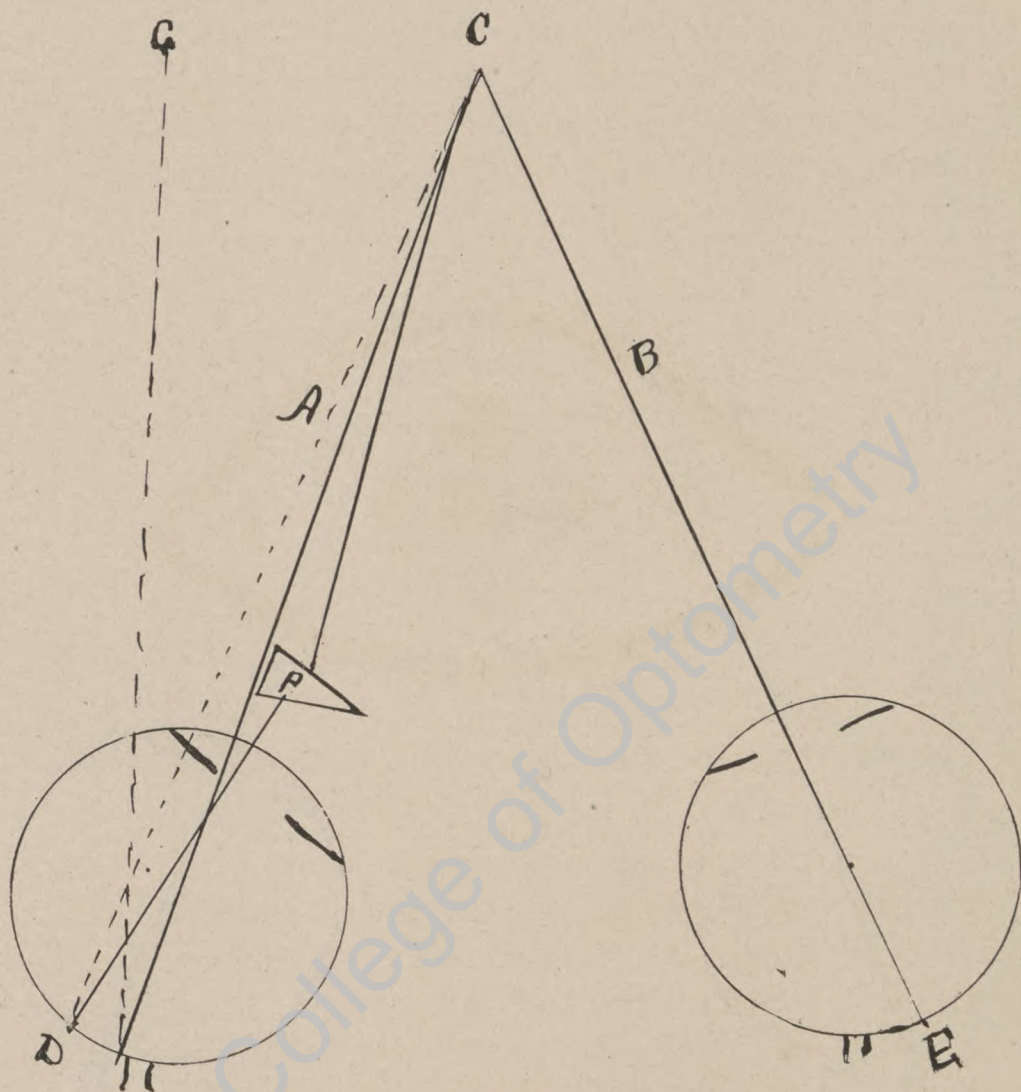


FIG. 53.

“ In recording the respective elements of such compound expressions I have employed the sign \perp . For example, if it is desired to indicate that the right visual line tends above its fellow 3° , and that there is a tending upward of 4° , the facts are noted thus: Right hyperesophoria, $3^\circ \perp 4^\circ$.”

Fig. 52 represents the two eyes; line (A) and (B) are axial rays of light emanating from flame (C); (D) and (E) the foveæ centrales; (Fig. 53) the same with an inward rotation of the left eye; and line (A) instead of reaching the fovea centralis (D) strikes the retina to the nasal side of it at (F) and because of the peculiar distribution of the optic nerve to the retina, projects the impression to point (G) causing a lateral displacement or separation in the opposite direction to the displacement of the eye, again calling to mind the rule for displacement of the image in the opposite direction to the deviation of the eye. (Plate X.)

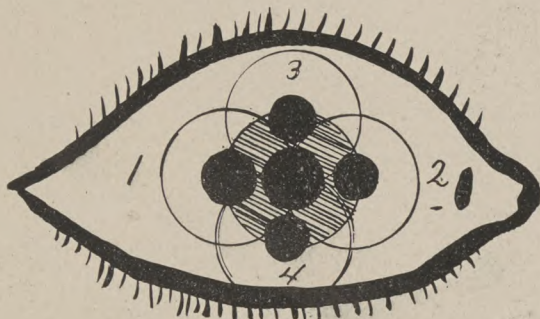


FIG. 54

Position of the pupil in—1. exophoria; 2. esophoria;
3. right hyperphoria; 4. left hyperphoria.

Muscular imbalance may remain latent, or masked, as long as the opposing muscles are able to maintain normal binocular fixation. As long as balance is maintained we have to deal with a condition of heterophoria.

The study of muscular balance may be carried on in several ways. I shall demonstrate the tests which I have found to be the most reliable and convenient, and which I use in every case coming under my observation for study and treatment.

First, the *objective* test. Sit in front of the patient, your eyes on a level with his. Hold a cover card over his right eye for a moment, then quickly uncover the eye and

note the position, or change of position, of the eye just uncovered. Then shift the card from over one eye to the other and note the movement of the uncovered eye. If the excursions made are sufficient for you to appreciate, according to the form of error, the eyes will quickly move from right to left, left to right, up or down, or obliquely if the error is compound. (See Fig. 54.)

The next test will be a *subjective* one, the *parallax test*. Place the patient twenty feet distant from a lighted candle, cover first one eye and then the other, and the patient will



a.

b.

FIG. 55.

a. Movement of the light in hyperphoria.

b. Movement of the lights in hyperexophoria.

notice an apparent change of position of the flame, indicated in Figs. 55, 56. Place the trial frames and introduce prisms, up or down, in or out, till the candle remains stationary. The next step will be to use either a Stevens phorometer (Fig. 57), which consists of two 4-degree prisms set in a frame so that they can be rotated against each other; or you can use the von Grafe method, an 8-degree prism placed base down before one eye, this displaces the image vertically, the second image being above, and brings out the manifest eso- or exophoria.

In order to avoid confusion in making these tests I always place the prism base down in front of the right eye, this will elevate the image seen with this eye. You can make it still more specific by placing a red glass over the left eye. If there is any exophoria the red light will pass to the right, if esophoria the red image will pass to the left. (Plate XI.)

Another valuable method has been introduced by Maddox, the rod test (Fig. 58). The rod disk is placed in the trial frame before the right eye, and the patient's gaze is directed toward a small bright light. He sees a bar or line of

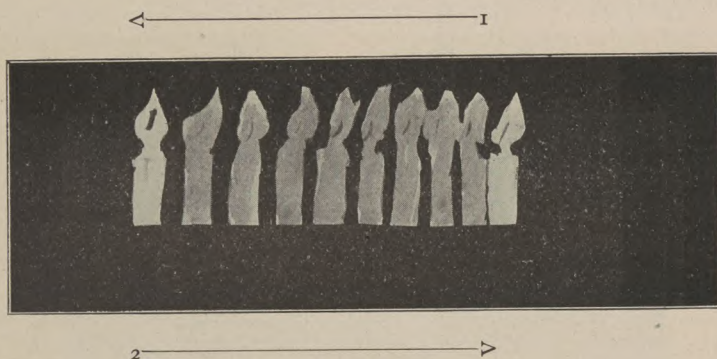


FIG. 56.

Cover first right eye, second, left eye.

1. Movement of light seen by right eye of an esophoric.
2. Movement of light seen by right eye of an exophoric.

light, and the light (Fig. 59). If the balance is normal the line will pass through the light, if abnormal it will pass above, below, to right or left as the error may be and the rod is placed.

The test may give the *manifest* or the *total* error. As we have nothing that will take the place which mydriatics do in refraction, we are obliged to coax out latent error. This is sometimes difficult to accomplish even though all signs point to the presence of an error of high degree. Before trying to develop the latent error the motility of the eyes should be recorded.

The test of power to overcome prisms.—When testing the duction begin with prisms of low degree, gradually increasing till diplopia is secured. The strongest prism used allowing of single vision indicates the degrees of abduction, base in, or adduction, base out. First, base in, will test the abducting power of the recti muscles, which should be 7° or 8° ; second, prisms, base out, to test the adducting power, which should be 40° to 50° ; third, prisms, base up or down, to test the sursumduction, which should be 2° to 3° .

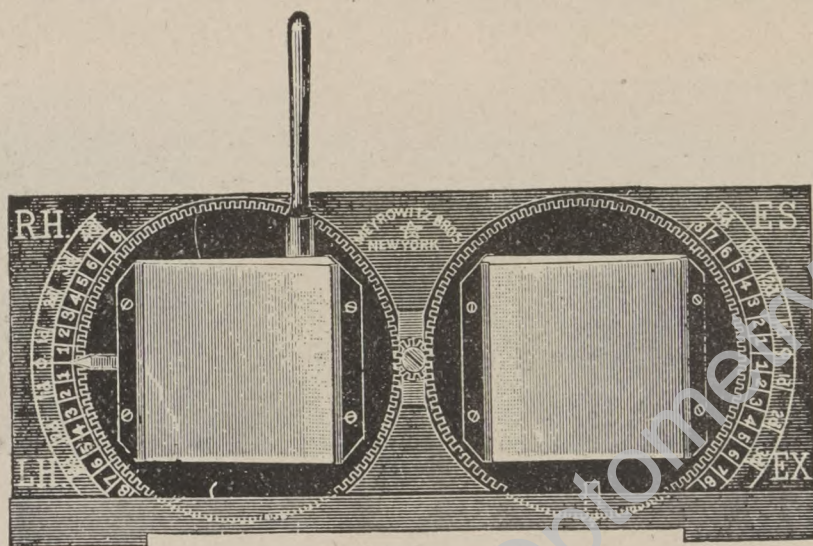


FIG. 57.

Normal adduction equals 40° to 50° .

Normal abduction equals 7° to 8° .

Normal sursumduction equals $1\frac{1}{2}^{\circ}$ to 3° (right and left).

It is necessary in taking these duction measurements that the tests should be made many times, and the full power of the muscles brought out before the final record is made.

A ray of light passing through a prism is deflected toward its base. (Fig. 60.)

The objective symptoms of heterophoria are: First—The expression of strain about the eyes, the corrugating and knitting of the brows and forehead, the drawing and grimacing of the facial muscles. (Fig. 61.) (The lines above and about the eyes, by their direction, and location, suggest the form of

error.) Second—Shifty eyes, where the patient is not able to look with steady gaze, the posing of the head to accommodate or relieve the weak muscles, and as a result of this torticollis a general mal-pose of the whole body. Third—The general symptoms of eye-strain.

In some of the cases which have come under my observation the objective symptoms have been entirely wanting, and not infrequently the reflex or remote results have been most severely impressed.

The subjective symptoms which have been attributed to heterophoria include so long a list of conditions, functional

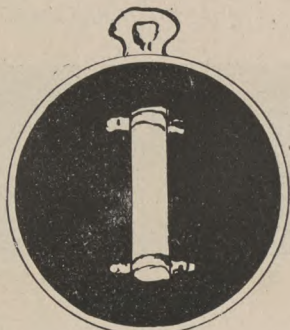


FIG. 58,
Maddox rod disk.

and organic, that I shall not attempt to enumerate them, but shall confine my recital to those which seem from my personal experience to be of value, and leave you who may care to do so to go over the literature of the subject. Like all new departures from the beaten path it has been trod by the wise and the unwise, the zealot and the conservative.

Local symptoms of heterophoria: Flushing and redness of the lids; redness of the globe, especially over the muscle receiving the greatest amount of strain; irritable iris with asthenopia; lameness and tenderness of the ocular muscles; slowness to begin their daily task; difficulty in performing work requiring a repetition of certain movements, or the main-

tenance of the eye in given positions for a considerable length of time. Vertigo; headache, frontal, parietal, or occipital; hemicrania, with or without scotoma, are the most common and important head symptoms. I have rarely known vertical headache to result from eye-strain, though it does occur. Nausea, acute and chronic indigestion, acute when temporarily doing work with the eyes which causes them severe strain, are the occasional symptoms.

In the class of cases where the gastric centers are involved it leads to the inclusion of a long chain of dependent troubles. Indigestion in its various forms, diarrhœa, constipation, hæmorrhoids, etc., may be indirectly caused by eye-strain, and, as a sequel, toxæmia and anæmia, etc.

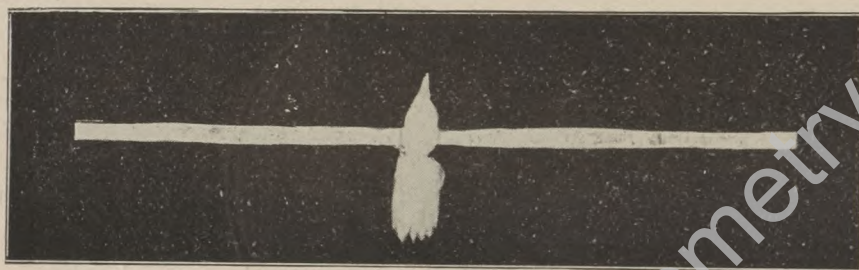


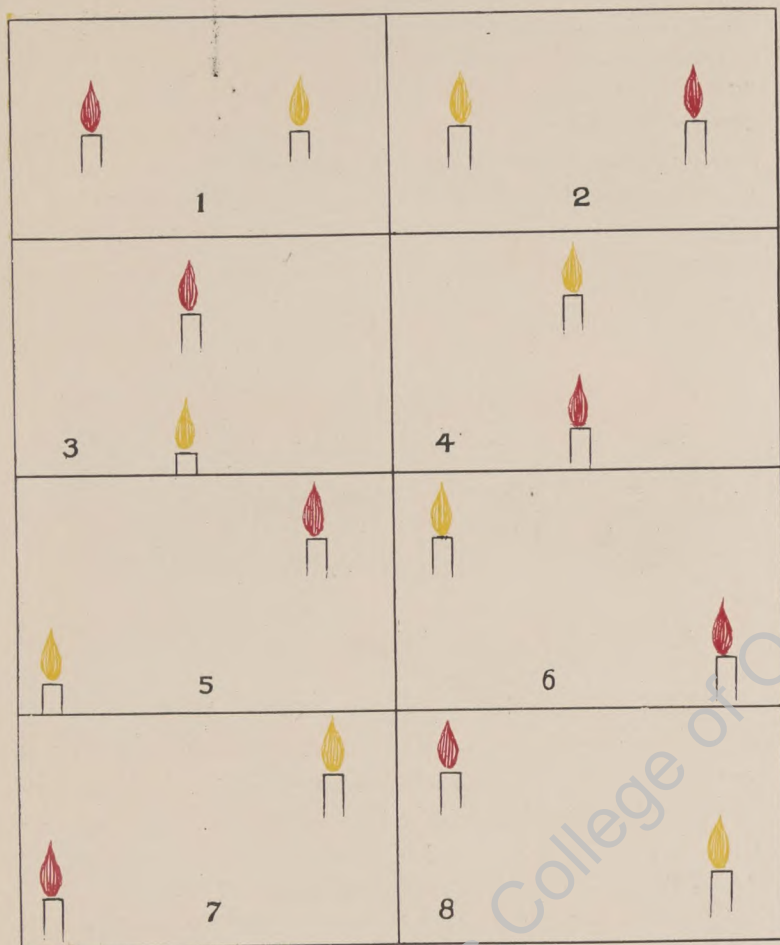
FIG. 59.

Maddox rod in front of right eye sees a bar of light, flame seen by left eye, orthophoria.

Some of the most annoying symptoms of neurasthenia such as inability to go down a flight of stairs, step over an open ditch or gutter, watch the movements of players on the stage, to look from one object to another, as an artist working from a model, or an accountant posting books, etc., have been relieved by restoring or establishing orthophoria.

Great care must be exercised in all cases of heterophoria to make a differential diagnosis between the *functional imbalance which is due to rheumatism, hysteria, neurasthenia, chorea of cerebral origin*, and the *early paralysis of true ataxia* and heterophoria of ocular origin.

The errors of refraction should be corrected and time enough allowed to lapse to secure relief from the strain of the



- Red glass over right eye.
1. Exophoria. 2. Esophoria. 3. Left hyperphoria. 4. Right hyperphoria.
 5. Left hyper-esophoria. 6. Right hyper-esophoria.
 7. Right hyper-exophoria. 8. Left hyper-exophoria.

PLATE XI.

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error of refraction. Prism exercise should be established and the general condition of the patient improved if possible before attempting the study and correction of the anomaly of the ocular muscles. Usually, however, the ophthalmologist is the court of last resort, and the patient is ready for his attention.

Diagnosis of Heterophoria.—The first step will be to determine the form of error. We will take it for granted that the abduction, adduction, and sursumduction have been taken. We find, for instance, that there is a hyperesophoria R. 4° \angle 10° , we desire now to know whether this is the total error. First, we place a 4° prism in a frame (base down, right eye, using a grab front if the patient is wearing a

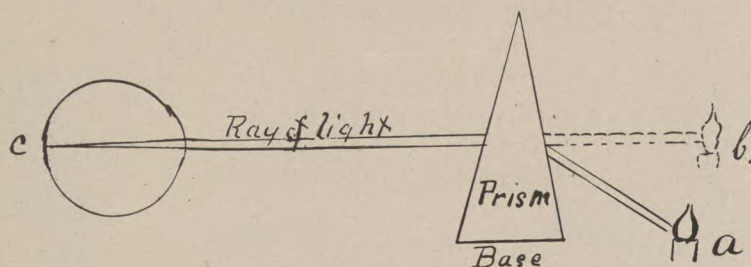


FIG. 60.

- a. the light.
- b. The position in which the light seems to be when seen through a prism.
- c. Fovae Centralis.

correction for an error of refraction), and direct him to walk about, read, or write; then, after an hour, with rest prisms still in position, place him in front of the light and displace the images laterally. If there is an increase of hyperphoria of one or more degrees, change the prism to 1° stronger. If the hyperphoria has not increased, direct the patient to wear the prism constantly, except while sleeping, until his return on the day following.

Second day's examination: Place the patient behind the phorometer with his rest prisms in position and again measure the error. Should there be an increase in the hyper-

phoria, add still further to the strength of the prism, and again have him read or write, or, if convenient, walk about for an hour, when, on his return, another examination can be made, taking a reading for both the hyperphoria and esophoria. If the esophoria still remains, and the abducting power is less than 7° , a prism of 9° , 1° less than the manifest error, should be placed base out before the other eye



FIG. 61.
Left hyperphoria.

Day after day this study is carried out until for four consecutive days the error in the vertical direction remains stationary. The test prisms should then be put aside for an hour and the parallax test given. Should this test give the same results as the phorometer, the superior rectus of the right eye can be tenotomized.

It is my rule to correct errors of 5° or less by a single operation. In a case of more than 6° to correct 4° to 5° in the hyperphoric eye and the balance in the fellow eye by a tenotomy of the inferior rectus. In anophoria, or where both eyes tend above the normal line, if the error of one is more than the other, a tenotomy of both superior recti is made, finishing with an advancement of the still hyperphoric eye.

One error should be corrected at a time if it is possible to do so, and from six days to four weeks allowed to lapse before the final consideration of the case. I have seen cases of hyper-esophoria or hyper-exophoria in which the correction of the vertical error was followed by the disappearance of the lateral deviation, also cases in which the lateral error developed to a higher degree of lateral divergence or convergence than could be made out before the operation.

The dosage of the operation: The operations for both graduated tenotomy and advancement are fully described under their proper headings in a previous lecture.

There is one point to which I desire to call your attention in connection with the operation, and that is the examination of the under surface of the tendon for connective tissue or check-ligament bands binding the tendon to the ocular wall. As soon as the tendon is "button-holed" pass the tenotomy hook into the sub-tendinous space, engage any bands which may bind the tendon to the globe back of the normal attachment and cut them off. Before going on with the operation, after the adventitious heads have been severed, test the muscle balance and complete the operation by partial section of the tendon if necessary for correction.

It has happened several times, after severing bands of this kind, that orthophoria has obtained without further tenotomy.

The extent of the partial or graduated tenotomy can only be determined by the character of the tendon, its attachment to the globe, and the amount of contraction taking place as the result of the operation. Experience alone can

be the guide as to the dosage. The beginner should make frequent tests during the operation to determine the result of each additional sectioning of the annular ligament. One or two degrees of over-correction will always be taken up in the process of healing.

Should there be an over-correction of more than two degrees a suture can be used to take up the excess. *Never tenotomize the opposing muscle to correct such a condition.* An under-correction can be corrected by advancement or shortening of the opposing muscle.

It is the consensus of opinion that the vertical error should be corrected first. In esophoria of high degree combined with hyperphoria I have frequently, however, corrected a part of the esophoria before correcting the hyperphoria.

The correction of the lateral error by operation should be preceded by a careful study of the relative freedom of the movements of the two eyes. If one eye is tardy and jerky in abduction and the fellow eye prompt and steady the first operation should be on the lagging eye.

The low degree of error, 8° or less, can be corrected in a single operation, 9° or more by a graduated tenotomy of the internus and an advancement of the externus.

Should both eyes be equally free in movement, with no posing of the head to indicate the weak muscle, the correction should be divided between the two eyes. A correction of a degree or two more than half the error is secured by the first operation, and ten days or two weeks elapse before the second operation, in which care must be used to secure one or two degrees of over-correction to allow for the contraction of the healing process.

The best results can only be obtained by patient study and deliberate procedure. When there is a doubt regarding the exact condition of balance it is much better to delay operations and afford such incomplete relief as can be obtained by the use of prisms combined with the correction for the error of refraction where it is necessary. A correction of one

degree or less may be prescribed, and will sometimes be found of benefit in low degrees of hyperphoria, and this only in certain kinds of work especially where the necessary rotation is but a few degrees from the median line.

Relief from adducting or abducting prisms is very doubtful. In most cases where I tried to give relief by their use I have been able to use only 2° in exophoria or 4° in esophoria, and that only for a short time. I now only use them under protest with patients who for some reason find it impossible to submit to an operation. A physician lately under my care wished to try prisms for the relief of asthenopia and migraine. At his request I gave him the equivalent of 2° base down over right eye, and 8° base in, 4° over each eye. He assured me that in using his eyes in the "straight ahead" position and at the horizon line he has relief, but in all other positions they gave him greater discomfort than the uncorrected error, and that he is now convinced that the only relief is an operation, for he is conscious of the asthenopia caused by the heterophoria.

In looking over my cases covering about fifteen years I find that there are experiences that will be of use to the beginner and, may be, to the more advanced student.

First: Reflex symptoms are more promptly relieved than local symptoms.

Second: That patients who have posed their heads and distorted their bodies to partially correct and lessen the discomforts of their error find it difficult to break up their acquired muscle habits and resume the normal position and that they are at first greatly inconvenienced by the orthophoric condition secured by the operation. In such cases I have found it necessary to refer them to the teacher of gymnastics to correct their muscle habits.

Third: That there is a class of uric-acidemia patients who must be put under careful general treatment and dieting, and held to the most rigid living before they find relief, even though the heterophoria may have been the exciting cause of

the trouble. But such patients are usually in the end rewarded by obtaining relief.

Fourth: That it is advisable to review the error of refraction after operations and recorrect it under atropine, for I have found astigmatism in some cases to be greatly increased and in others to diminish or disappear following the correction of the heterophoria.

Fifth: That a correction of the heterophoria may be followed by a marked change in the pose of the body, that a stooping, shortened front line may be corrected and the two become erect and normal.

This is especially true when both the visual lines are at greatest ease when directed above the normal plane.

Retinal Epilepsy; Migraine. Hyperphoria with Secondary Esophoria.—This patient, Mr. H., aged thirty-four years, has been employed in active out-of-door life for several years. At fifteen years of age he was obliged to leave school on account of his headaches, chorea (first facial and later general), and stomach disorders.

Recently he has endeavored to prepare himself for a more responsible position which will require him to keep books and do additional writing and other close work. The return to close work and study has caused him to again suffer from stomach disorders and headaches. He has been advised that the cause of the trouble is eye-strain, as the headache is frontal and occipital, and always follows close work. The headache comes on in the afternoon and is only relieved by sleep; or it may come on soon after waking in the morning and last all day or until sundown. In addition to the headache he has occasional attacks of scintillating scotoma, usually in the right upper field of both eyes, followed by a "blind spell" and later a severe hemicrania, lasting from twelve to twenty-four hours. At times there is delirium and suicidal mania. Large hypodermics of morphia are required to secure quiet and rest. Lately in addition to the forego-

ing he has had several attacks of severe vertigo, and mental confusion. The gastric disorder, greater during the headache periods, is now constant, causing vomiting and hyperacidity. The urine is scanty previous to attacks and excessive following them. He has had competent and thorough medical treatment resulting only in palliating the symptoms. He came to me through his family physician.

Family history: Mother living and in good health: father died at the age of forty-two years from chronic albuminuria. He was a mechanic but had to abandon the trade on account of severe headaches and general poor health. Albuminuria was discovered by an insurance examiner. He died

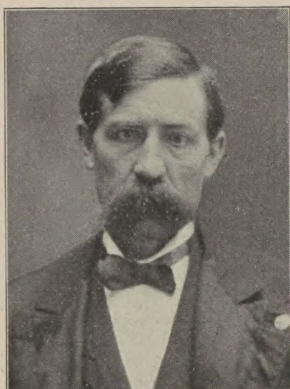


FIG. 62

four years later, having lost his vision about eight months before death from albuminuric retinitis. Two sisters of our patient are also subject to headaches and ophthalmic migraine. His eldest child, a boy of twelve, who closely resembles him, is already suffering from headaches.

Examination (Fig. 62); I desire before taking up the study of the eye balance to call your attention to the pose of the patient's head, and his facial expression. The head is inclined forward, both brows elevated, the right more than

the left, and the forehead deeply furrowed. The chin is retracted and the shoulders are stooped. This is the usual appearance of patients suffering from hyperphoria.

Our patient has now been under observation for sixteen days, the record of examination you will find in the chart. He has been refracted and found to have no errors. He has a

Name,	<i>Mr. H. aged. 34</i>									
No.	<i>864 no error of refraction</i>									
Date,	<i>2.12/90 12th 16th 20th 24th 28th Mar 4 18</i>									
Hyperph., R.	<i>12°</i>	<i>14</i>	<i>14</i>	<i>14</i>	<i>14</i>					
Hyperph., L.						<i>1°</i>	<i>1/2°</i>	<i>0</i>		
Esophor.,	<i>7</i>	<i>7</i>	<i>7</i>	<i>6</i>	<i>5</i>		<i>0</i>			
Esop. in A.										
Exophor.,										
Exop. in A.										
Abduction,	<i>7</i>	<i>7</i>	<i>7</i>	<i>7</i>	<i>7</i>					
Adduction,	<i>40</i>	<i>48</i>	<i>48</i>	<i>48</i>	<i>48</i>					
Surcum., R.										
Surcum., L.										
Parallax Test.	Hyperph.,	<i>R 10°</i>	<i>14°</i>	<i>14</i>	<i>14</i>		<i>0</i>	<i>0</i>		
	Esophoria,	<i>6°</i>	<i>6</i>							
	Exophoria,	<i>40°</i>	<i>20</i>							
	Rest Prisms.	<i>12</i>	<i>12</i>	<i>13</i>	<i>14</i>	<i>14</i>				

Remarks:

right hyperesophoria 14° | 7° . He first gave a hyperphoria of 12° ; by rest prisms and exercise he has given a manifest error of 14° for twelve days. I conclude that this is the total error and shall operate for its correction, operating as described in previous lectures. The result of the operation gives a left hyperphoria of 1° .

(March 18.) It is now eighteen days since the operation, there is perfect muscle balance, the hyperphoria is corrected



PLATE XII.

Scintillating scotoma, occurring in an artist, the impression here shown being drawn by him from the mental picture thereof.

Digitized by Illinois College of Optometry

and the esophoria evidently dependent upon it has disappeared. I desire to call your attention to the fact that although he has used his eyes freely since the first rest prisms were adjusted, he has had no return of the scotoma or hemicrania, has suffered but little from headache, and that mostly during the time the eye was tender from the operation. There has also been a marked improvement in the digestive tract. During the past ten days he has used his eyes for close work for four or five hours a day.

I desire to call your attention to the fact that by none of our tests are we able to detect any error in direction. Fourteen degrees were corrected by a single operation and without separating the lateral fibres of the annular ligament of the superior rectus muscle. I have rarely been able to secure so great an effect by a single operation. During our examination and before the operation whenever the test prisms were removed and the patient forced into the erect position, he would have diplopia and vertigo. His physician reported that he had one epileptiform attack on arising and attempting to go about without his rest prisms.

Note: In compliance with a request, the patient reported to me a few days ago, several years after the operations. I find on examination that he has perfect muscle balance, that he has been using his eyes for more than eight hours a day at close work, and that there has been only an occasional headache, and only one attack of scintillating scotoma, which seemed to have been the result of exposure to bright sunshine on the water. We have had a case of heterophoria eye strain as an exciting cause for habitual headache, stomach trouble, and ophthalmic migraine. The predisposing cause to these manifestations may have been inherited tendency to renal insufficiency and a neurotic temperament.

Hyperphoria may cause secondary esophoria, or exophoria, and its correction may be followed by the re-establishment of normal lateral balance. It frequently occurs that a compound error may remain latent and be, so far as the patient is aware,

innocuous till after thirty years of age, and then suddenly become annoying. This may happen in cases where the pose of the head, the expression of the face, and scowling of the forehead indicate its presence.



FIG. 63.

This patient, Mr. L., a farmer and gardener, aged thirty-four years, married, came to me about six years ago on account of severe headaches. His general health was good with the exception of a severe attack of indigestion. I refracted him under atropine and corrected a compound hypermetropic astigmatism; O. D. +1.00 sp., +.75 cy., ax. 90°; O. S. +1.50

sp., +1.25 cy., ax. 90°. At the time of his examination I found a manifest hyperphoria of 1° in the right eye and an esophoria manifest, of 8°. I advised him to wear his glasses for a time and return to me if he did not get relief from his headaches.

To-day he comes again complaining of the return of severe headache from which he had been free for about four

Name, <i>Mr. L.</i>											
No.											
Date, <i>1892.7.4</i>											
Hyperph. R.		<i>1</i>		<i>4 1/2</i>	<i>8</i>	<i>8 1/2</i>	<i>8 1/2</i>			<i>0</i>	
Hyperph. L.		<i>0</i>							<i>1 1/2</i>	<i>0</i>	
Esophor.		<i>8</i>		<i>8</i>	<i>8</i>	<i>8</i>	<i>8</i>				
Esop. in A.											
Exophor.											
Exop. in A.											
Abduction,						<i>7</i>					
Adduction,						<i>40</i>					
Surcum, R.						<i>8</i>					
Surcum, L.						<i>-7</i>					
Purkinje Test.	Hyperph., <i>R</i>			<i>4</i>	<i>8</i>						
	Esophoria,			<i>10</i>	<i>10</i>						
	Exophoria,										
Rest Prisms.				<i>4/10</i>	<i>4/10</i>						

Remarks:

and one-half years. He has been refracted and no change found necessary. The manifest hyperphoria has increased and to-day he has $4\frac{1}{2}^\circ$, the esophoria of 8° remains the same. He has been subject to attacks of vertigo, especially while working in the garden at thinning out plants. The headaches are more severe while he is doing work requiring him

to look downward. He has worn rest prisms for an hour and there is now 7° of hyperphoria.

(Ten days later.) I will give you the history of our examinations made each clinic day. You will notice that he now has a right hyperphoria of $8\frac{1}{2}^{\circ}$ and that the last two examinations have given no increase. He is now ready for operation. The right eye now remains high, and, when the left is covered, comes slowly into place. The movements of the left eye are normal and unimpeded. I shall tenotomize the right superior rectus, and advance the inferior of the same eye, for the error seems to be in the right eye, as the habitual pose of the head seems to indicate. The head is inclined forward and the chin to the right. (For operation see Vol. XIII, No. 6, page 420.) The result of the operation is a left hyperphoria of $1\frac{1}{2}^{\circ}$.

(Two months after the operation.) Mr. L. calls at my request and we find $\frac{1}{4}^{\circ}$ of right hyperphoria. He has been free from headaches, vertigo, and nausea. During the winter evenings he has been able to read for two or three hours at a time without discomfort. The esophoria has almost disappeared, at least I have not been able to bring it out by the use of the usual tests. We shall expect to find that it was secondary to the esophoria.

This patient, Mr. F., aged forty-one, a clergyman by profession, has been suffering from the serious and multitudinous symptoms of neurasthenia, chief amongst them being facial chorea, petit mal, insomnia, and pain in the lower part of the back and thighs. He has been unable to attend to his duties as a minister, and on account of the vertigo and little fits has not been able to go about unattended. Refraction shows—6.00 D. in both eyes. Exophoria equals 15° (rod test). Is never conscious of double vision except when coming out of fits, or sometimes before losing consciousness. With the phorometer test, red light over right eye, exophoria equals 18° . Adduction, each eye tested separately, normal with

phorometer (Stevens) abduction equals 22° , adduction 4° . During this test he was seized with a severe attack of vertigo. This chart gives the history of the case up to the second operation. The first operation was a graduated tenotomy of the left externus and the advancement of the internus resulted in correcting 18° of the total error of 26° .

The large amount of correction obtained from the first operation was desired on account of the habitual pose of the

Name, Rev. F.

No.

Date, 1894. 9. 6, 7, 15, 20, 24, 44. 6 7 12 16 28

[illegible]

Remarks;

head to the left. This we have fully corrected. You will notice that the adduction is now 30° and the abduction 4° . It is now two months since the first operation.

The result of a tenotomy just completed is an esophoria of 3° .

(Later report by letter from patient.) "I am now able to use my eyes from four to eight hours a day. I have re-

covered my health. With the prisms used for exercise, am able to find but 1° of exophoria."

This patient, Miss B., aged twenty-two, has suffered from constant headache with occasional attacks of migraine since her fourteenth year. Three years ago she was obliged to leave school on account of headaches and facial chorea; at that time she was refracted and a full correction given. For a time her headaches were less severe and not as constant. She returned to her school work and in a short time

Name,	<i>Miss B. age 22</i>											
No.												
Date,	<i>Dec</i>	<i>4</i>	<i>6</i>	<i>9</i>	<i>15</i>	<i>20</i>	<i>30</i>	<i>Apr 4</i>	<i>18</i>	<i>24</i>	<i>30</i>	<i>May 1</i>
Hyperph. R.		<i>4</i>	<i>4</i>	<i>4</i>	<i>4</i>		<i>0</i>					
Hyperph. L.		<i>0</i>				<i>1/2</i>	<i>0</i>					
Esophor.		<i>0</i>										<i>1/2</i>
Esop. in A.		<i>6</i>										
Exophor.		<i>18</i>	<i>18</i>	<i>18</i>	<i>18</i>		<i>16</i>	<i>18</i>	<i>19</i>	<i>18</i>	<i>10</i>	<i>0</i>
Exop. in A.		<i>18</i>	<i>18</i>									
Abduction.		<i>10</i>						<i>10</i>	<i>10</i>			<i>18</i>
Adduction.		<i>20</i>						<i>20</i>	<i>24</i>			<i>28</i>
Surcum. R.		<i>4</i>										
Surcum. L.		<i>0</i>										
Parallax Test.	Hyperph.	<i>4</i>	<i>4</i>	<i>4</i>	<i>4</i>	<i>Op. R.S.R.</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>Op. R.S.R.</i>		<i>0</i>
	Esophoria.											<i>0</i>
	Exophoria.	<i>16</i>	<i>18</i>	<i>24</i>	<i>24</i>			<i>18</i>	<i>18</i>			<i>0</i>
Rest Prisms.		<i>3</i>	<i>15</i>	<i>X</i>	<i>X</i>			<i>14</i>				

Remarks:

the old troubles were on in full force. Four months ago she was referred to me for examination with the following results:

Right hyperphoria = 4° . Exophoria = 18° . Error of refraction which had been perfectly corrected three years ago:

O. D. = +1.00 sp., +1.50 cy., ax. 90° .

O. S. = +1.00 sp., +1.50 cy., ax. 90° .

This chart will give the history of our study of the case and our operations.

It is now three months since the last operation and during that time there has been no severe headache and only one attack of migraine. I shall now correct the remaining exophoria by an advancement of the left internal rectus.

(Note.—The headaches and migraine have not recurred during the past eighteen months. For nine months the patient has been doing full work in a college course.)

The case which I present to you to-day is one of interest. Before the patient is brought in I will give you a brief outline of her history.

From early childhood she has been subject to severe headaches and pain in and about her eyes; at ten years of age she had short periods of diplopia and manifest squint. This condition continued till her fourteenth year, when she was examined and glasses prescribed. Up to this time her headaches were constant, with severe pain in the afternoon which frequently sent her to bed by four o'clock. She, at this time, received a severe nervous shock, became unconscious for a time and afterwards hysterical. She was confined to her bed for several days and when she recovered from the illness complained of a distress in her head, which she described as being *like a pain*. This became a constant condition. She then developed scintillating scotoma and attacks of hemianopsia, with severe headaches lasting for hours. Following these attacks she had epileptiform seizures with hysterical symptoms and red-blindness. Her general condition became one of extreme anæmia. From this she improved, and her weight, which had been below normal, increased, but the general nervous tone did not improve. Any prolonged use of her eyes was followed by severe headache, or rather head distress.

She is now sixteen years of age, about normal in weight, gums are normal in color, and the report of an examination in the general medical clinic classes her in a healthy condition. She is silent and moody in manner; extremely nervous

and sensitive to surroundings. You will notice that the eyes are deeply set and that her gaze is unsteady and shifting; that her head is moved about to suit the direction of her gaze; that she keeps her eyes fixed upon the floor with the head inclined to the right.

The error of refraction is:

O. D. +4.00 sp., +1.25 cy., ax. 90°.

O. S. +4.00 sp., +1.25 cy., ax. 90°.

With her full correction she had a left hyperphoria of 4°, and an esophoria of 14° with ruby glass before either eye. With the phorometer left hyperphoria 4°, and esophoria 38°. With a red glass over right eye 30° of adducting prism was required for fusion, and she could overcome more than 60° of adduction.

About four months ago I corrected the hyperphoria by operating upon the right inferior rectus. I shall now have an anæsthetic administered and do a double graduated tenotomy on both internal recti, free the contracted check ligaments, and advance the external recti, leaving the sutures so that I can increase or decrease the effect of the operation as seems best after the anæsthesia has fully passed off.

I find it very difficult to secure good results when operating upon patients under general anæsthesia, and should not do so now but for the annoyance experienced in controlling the patient while operating upon the inferior rectus.

It is desirable to secure 2 to 4 degrees of over-correction, for I have found that 2° of over-effect in correcting the hyperphoria disappeared with the healing of the wound.

(Note.) January 4, 1901. The patient has 6° of esophoria, is able to use her eyes for about four hours each day, has occasional attacks of headache, but not of "distress of the head." Is happy and hopeful. It is nearly one year since the last attack of hysteria. She is still inclined to hold her head in the katophoric position and finds it difficult to walk with the head erect. Last operation two years ago.

A case of asthenopia relieved by correcting glasses and prism drill.

This case, Master L., aged eighteen, has been doing close work for three years, during the past four years being subject to headaches. Three months ago he gave up his



FIG. 64.

position because he could not do the work required in adjusting and assembling bicycle parts.

When he came to the clinic he had occasional attacks of diplopia, with constant confusion, and headache when he did any form of close work. He had an esophoria of 16° with

red glass and could not secure fusion for four or five hours after the test. Adduction equaled 50° ; abduction 2° .

Error of refraction:

O. D. +2.50 sp., +.75 cy., ax. 90° .

O. S. +3.00 sp., +1.50 cy., ax. 90° .

With correction adduction equaled 50° ; abduction 6° ; esophoria 5° . I gave exercise prism, 4° , base in, for ten minutes, morning, noon and night; and at the end of three weeks the asthenopia had disappeared and orthophoria was established.

This patient is one of the most typical of the neurasthenic class. Male, aged twenty-eight. Has a long list of symptoms which he is fond of recounting, but most noteworthy is the constant occipital headache. Indigestion, constipation, cold hands and feet, mental depression, followed by periods of exhilaration, dread of places and people, neuralgic pains with depression, urine storms, etc. When he leads a free, out-of-door life, and does not attempt to do any systematic work, he suffers but little; but as soon as he undertakes any work requiring mental application, or attempts to read or write, the mental confusion returns and severe headache and eye-strain pains follow. He has been a man of good habits and regular life. About six years ago he was forced to leave school by the beginning of this trouble. Twice since that time he has attempted close work, but always with the result of bringing about a relapse of the trouble. Eight months ago he first came to the clinic, and we examined his eyes, correcting an error of refraction. He at once felt the relief afforded by the correction:

O. D. +1.00 sp., +.75 cy., ax. 120° ,

O. S. +1.00 sp., +.75 cy., ax. 45° ,

and was quite sanguine of obtaining complete cure. We tested his muscle balance at that time, finding a left hyperphoria of 4° , and an exophoria of 12° , though at that time

nothing was said to the patient regarding the matter. About one month after correcting the error of refraction our patient returned and I re-examined his muscle error, at this time the exophoria equaled 15° , hyperphoria 6° . He was having attacks of migraine once in two or three days. Thinking that he might be having the early symptoms of cord degeneration I made a careful review of the muscle condition and found that the field of binocular fixation was normal, but that the hyperphoria was the undoubted cause of the exophoria. Rest prisms gave him much relief, though he could not walk about with comfort. As he had been through the most approved treatment for the general condition, with only temporary good results and never with any relief from the asthenopia which prevented him from reading and studying, I advised an operation for the correction of the hyperphoria, which equaled 6° . As he was inclined to throw his head forward in doing any kind of close work I concluded to tenotomize the left superior rectus and advance the left inferior rectus. The second day after the operation the effect of the advancement seemed to be too great and under holocain I severed the central stitch which allowed the eye but one degree of right hyperphoria. After ten days the test gave perfect orthophoria. He comes to-day to report his condition.

He says he can use his eyes for reading and writing about four hours each day; that the asthenopia has wholly disappeared, and that the only discomfort now experienced is one of general fatigue. There has been some improvement in his general health, but he cannot sustain mental effort more than an hour or two at a time. He is now on his way to take charge of some part of a mining works where he will be out of doors much of the time and can regulate his hours of labor.

The patient I now present to you has been under observation for some months. She is a sewing girl and has not been able to control her time so that we could do the best work for her. It is important that the period of study of a

case should be long enough to develop the full amount of latent error. As this takes much time, and frequent visits, the patients of the class coming to the clinics are often not the best to study, and we are occasionally obliged to operate for errors that are not fully developed, correcting the amount that can be made out during a short vacation, which may represent but part of the total error.

The case we have before us is one of this class. The history will illustrate the difficulties overcome, and is furnished by my assistant, Dr. Mahoney. The result of our work has been satisfactory, if the method of doing it was not.

Miss M., aged twenty. Exophoria was first made out at an examination made about May, 1894, three years after the first use of glasses.

August 30, 1894. Presented herself for examination at which time was found: Exophoria, manifest, 1° ; power of abduction, 9° ; adduction, 24° . Muscle exercise by use of the prisms was now instituted, and November 8th power of abduction remained 9° , adduction being increased to 35° .

November 20, 1894. Examination reveals exophoria of 5° in accommodation, 2° for distance, for the correction of which a graduated tenotomy of both external recti was performed December 1, 1894.

April 20, 1895. A latent exophoria of 8° found to exist for which a graduated tenotomy was done upon the left external rectus. She was again carefully refracted under homatropine, accepting:

O. D. +.50 sp., +1.00 cy., ax., 90° .

O. S. +.50 sp., +1.00 cy., ax. 90° .

For two months following the second operation the visual lines remained normal, then a slight divergence again manifested itself.

Oct. 11, 1895. Examination reveals 5° of exophoria, relieved by a graduated tenotomy of right external rectus.

October 15, 1895. Visual lines normal.

Our patient has had free use of her eyes for some months

without discomfort and there is perfect orthophoria. In this case we had to depend upon our patient to use the exercise prisms at home and to give us such observations as she was able to furnish at long intervals.

Asthenopia of one form or another frequently interferes with the plans of students and diverts them into fields of uncongenial labor for which they often are not mentally or physically fitted. The young man now before us has been obliged to abandon a technical course on account of eye-strain, and he has spent all that he could earn or command to get relief so that he could continue his study. He has been under the care of physicians, special and general, and all have told him that he must give up all hope of continuing school work or any occupation requiring continued use of his eyes at short range. I call your attention to him because he has tried almost every kind of cure, from the Keeley to the "faith-cure," and has been considered a confirmed neurasthenic and a hypochondriac. He has been refracted, has worn prisms, and used electric belts all to no purpose; for as soon as he attempted to do any kind of work he would begin to suffer an occipital headache, which would end in two or three days with a severe and prostrating migraine, from which he recovered very slowly. Should he persist in his attempts at work he would soon be in a condition of general physical prostration. He came to our clinic about fourteen months ago, just as he was recovering from one of these attacks, and gave, aside from what I have just outlined, the following history: Twenty-two years of age; has had from early childhood headaches, red lids and attacks of inflammation of the conjunctiva; could read, write, or do close work during the morning hours with but little discomfort; headaches came on in the afternoon, and if close work was continued a severe attack by 4 p. m., rendering it necessary to retire by 6 or 7 p. m. on account of the pain and nausea; is subject to car sickness; could not swing, play at games of ball or marbles; his eyes were never without dis-

comfort and conscious strain. At sixteen years of age a vendor gave him glasses which afforded some relief. With the aid of a younger brother he was able to finish high-school and attempted to study electrical engineering, when severe attacks of migraine forced him to abandon school. He was refracted at this time and an accurate correction given; cannabis indica prescribed for the migraine; strychnia, iron and other tonics administered; protracted rest, country life, gymnastics, etc., all of which were beneficial, but at every attempt to use the eyes a relapse would follow.

Prisms were prescribed to correct a manifest exophoria, but the result was the same. He was referred here on account of an episcleritis involving both eyes over the insertion of the internal recti muscles.

Atropia was used, and his refraction after the fourth day gave:

O. D. +1.25 sp., +.75 cy., ax., 180° , $V = \frac{20}{20}$.

O. S. +1.25 sp., +1.25 cy., ax., 90° , $V = \frac{20}{20}$.

The accompanying chart will give the history of our work. The result of our study and his patient endeavor is that he has been able to do three months of close work, averaging six hours a day in the class-room and two hours in the shop, with no discomfort beyond that of ordinary fatigue. The unusual and perplexing condition which gave so much delay was a manifest exophoria of 12° which changed to an esophoria after the correction of the hyperphoria, by tenotomy of the superior rectus of the right eye and the inferior rectus of the left eye. On account of the change of deviation I advised a delay of some weeks, and the use of prism exercises. As the abduction did not improve and the esophoria remained constant at 17° , tenotomies were done on the internal recti, correcting 15° of the error. The result justified the operation and the asthenopia gradually ceased.

I desire to impress upon you the importance of careful refraction after correcting the hyperphoria. It should be done under atropine and within two or three weeks following

the last operation. In the case under consideration the astigmatism wholly disappeared, leaving only the hypermetropia. I expected a change, for we found it difficult to correct the astigmatism even under protracted mydriasis.

Low degrees of hyperphoria may be corrected by decentering spherical or sphero-cylindrical lenses, and, if the error and axis will allow, cylindrical lenses, or by combining the prism with the spherical or cylindrical correction. I have

Name, *Mr. W. age 26 yo.*

No.										
Date.	<i>1889</i>	<i>5</i>	<i>11</i>	<i>26</i>	<i>27</i>	<i>9</i>	<i>16</i>	<i>29</i>	<i>1890</i>	<i>1893</i>
Hyperph. R.		<i>0</i>	<i>0</i>	<i>0</i>					<i>(4)</i>	<i>4</i>
Hyperph. L.										<i>4</i>
Esophor.		<i>10</i>	<i>16</i>	<i>16</i>	<i>7</i>	<i>9</i>	<i>9</i>	<i>1</i>	<i>14</i>	
Esop. in A.		<i>0</i>								
Exophor.										
Exop. in A.										
Abduction.		<i>3</i>	<i>3</i>			<i>3</i>	<i>5</i>			
Adduction.		<i>40</i>	<i>60</i>			<i>50</i>	<i>60</i>			
Surcum. R.		<i>1 1/2</i>	<i>1</i>			<i>1</i>	<i>1</i>			
Surcum. L.		<i>1 1/2</i>	<i>1</i>			<i>1</i>	<i>1</i>			
Hyperph.		<i>0</i>								
Esophoria.		<i>14</i>	<i>15</i>			<i>7</i>	<i>8</i>			
Exophoria.		<i>0</i>								
Rest Prism.		<i>8</i>	<i>14</i>	<i>14</i>						

Remarks:

never found it possible to correct more than 1 or $1\frac{1}{2}^{\circ}$ of hyperphoria with the prism or decentered lens.

This case has been under our observation for some months, and at my request comes to report her condition. She is twenty-six years of age and has been a bookkeeper for five years. About two years ago she came to the clinic for the correction of an error of refraction. Eighteen months later she returned with the complaint that she could work longer with her glasses than without them, but that she still

had too much asthenopia to do a full day's work on her books, especially when looking up and down the long pages of a ledger.

The error of refraction was carefully corrected ; she was under atropine for four days ; her lenses were inspected to see that they compared with the prescription. When she was first examined hyperphoria of $1\frac{1}{2}^{\circ}$ was found, but no eso- or exophoria. Abduction and adduction normal. We gave her rest prisms to use, and she found in them so much relief that she did not return for two weeks for a second consultation. When she returned we found that the hyperphoria had not changed, and the parallax test agreed with the phorometer. We also advised her to have the prism combined with the sphero-cylinder.

I prefer the lens, including both the sphere and the prism, for I am sure then that for all positions the prism is of the same strength. I have given her this correction because it seemed the best thing to do under the circumstances. She could not give the time required for operative treatment, and while the prism does not give complete relief for the entire range of motion, it does render her labor easier in the position in which the eyes are most used.

We are frequently able to bridge over a period of unavoidable delay until time and opportunity are favorable to further study and treatment.

This case is a fair illustration of the effect of hyperphoria upon the earning capacity of a man in robust general health. Mr. H. is thirty-four years of age, has always had good general health; is of robust, athletic build and habit. His history is good and habits temperate.

About six years ago he was obliged to give up his position as an accountant and book-keeper owing to severe headaches and pain in the chest and shoulders. After a brief rest or change to an active out-of-door life he returned to his former occupation. He soon had to give up the effort to do

close work, and after an unsuccessful attempt at ranching and farming returned to this city to find some form of employment suitable to his taste and training. He was referred to this clinic some months ago to have his eyes tested before attempting close work. The examination under complete mydriasis was: O. D.—1.75 sp., O. S.—1.75 sp. There was no evidence of choroidal disease and the condition seemed to be one of physiological myopia.

The test with the phorometer showed a left hyperphoria of $4\frac{1}{2}^{\circ}$. There was a functional esophoria of 2° to 4° which disappeared as soon as the hyperphoria was neutralized by prisms. The manifest hyperphoria proved to be the total error.

A graduated tenotomy of the superior rectus of the left eye corrected the imbalance. Within the following month he was able to resume his vocation and has worked eight or ten hours a day for seven months; has had no return of the headache and to-day has perfect orthophoria.

Heterophoria may enter into a condition causing irritation and may be only one of many factors which produce the asthenopia. The relief of the imbalance is, however, the first step in securing relief. In many cases we have to deal with an error of refraction, a heterophoria, imperfect illumination, faulty position during working hours, and bad habits in eating and resting. We have many cases giving all the symptoms of muscular asthenopia in which there is no error of direction or tending to misdirect the visual lines, and no error of refraction. These are due to temporary disturbance of function from auto-intoxication, caused by imperfect menstruation, stomach or bowel indigestion, torpid liver or other organic or functional disturbances. Such cases will give functional esophoria or exophoria, which are changeful in degree and form.

In this patient, Miss S. M. T., aged 24 years, a stenographer, we have a good illustration of this phase of the subject. She has all the symptoms of severe eye-strain-pain in and

about the eyes, flushing of the lids, inability to fix the gaze upon the work, blurring of the type, doubling of letters and words, and attacks of sick-headache.

She was referred for examination during one of these attacks. Under complete mydriasis she was found to have normal refraction. The phorometer gave on one day an esophoria of 7° , on the next an esophoria of 10° . The rest prisms cause extreme annoyance and discomfort. The third examination, one week later, gave no evidence of heterophoria by any test. I requested her to call in about two weeks for another examination. She returns now with the beginning of the usual monthly attack of asthenopia. Her eyes are flushed and tender to pressure, every change in their position is attended by lameness and pain. She has spasm of accommodation demanding—1.00 D. to read the 20/20 line of type. An exophoria of 4° ; abduction, $=6^{\circ}$; adduction, $=24^{\circ}$; sursumduction, R. $=1.50^{\circ}$; L. $=1.50^{\circ}$.

This is a case of functional asthenopia, and must be referred to the general medical clinic for further consideration.

Miss S., aged twenty-eight, in poor general health, anæmic, with an unhealthy skin, furred and indented tongue. She was referred to us for examination. Her eyelids are thickened and the tarsal conjunctiva is red and inflamed. The eyes are tender to deep pressure. She is found to have no error of refraction, there is a manifest exophoria of uncertain degree, not relieved by prisms and not a constant condition. This is her fourth visit, and I am convinced from the examination that there is only a disturbance of function, for we have not been able to develop any fixed condition of imbalance. But by administering aids to digestion and cleaning out the *primæviæ* with calomel and following with a modified diet, and the use of salol and guaiacol, we have been able to relieve the asthenopia and prove that the muscles of the eyes were suffering, as other muscles of the body may, from the effects of auto-intoxication. I shall, however, desire to see what can be

done by general treatment before conceding the condition of the eyes a possible cause of the asthenopia.

The eye muscles may partake of the general muscular weakness which results from any form of debilitating disease. It frequently occurs that children with errors of refraction or with normal eyes are allowed to read and write, and do other work requiring close vision during convalescence from measles, scarlatina, etc., and in so doing fatigue the weakened muscles of accommodation and direction. The over-taxed eyes become irritated, not infrequently inflamed, and heterophoric, and if the attending conditions are favorable a condition of asthenopia is established which may last the lifetime of the patient, even though every known remedy has been tried for its relief.

Long-continued use of the eyes under unfavorable conditions of refraction, accommodation, and balance, even though the general health is good, also produces a condition of irritability which may never be wholly overcome. So far as the muscles are concerned there may be a partial relapse, or periods while the general health is below par, when the asthenopic symptoms will return in full force, though the heterophoria does not exist. The old central irritation has been relighted and the pain and discomfort for a time renders any use of the eyes distressing.

In other cases there seems to be a disposition to relapse, either from incomplete correction or from tendency of the tendon and check ligament to shorten from habitual over-nutrition. To illustrate I will review for you one of my private cases. I have had this patient under occasional observation for fourteen years.

Mr. W., aged 22 years, occupation sedentary, consulted me in 1887 for asthenopia. I refracted him carefully under atropia used four days, and corrected a hypermetropia:

O. D. +1.00 sp., +1.25 cy., ax. 90°.

O. S. +1.00 sp., +1.25 cy., ax. 90°.

He would only accept at that time a cylindrical correction

and for some months this correction gave him comparative comfort, though the asthenopia was by no means fully relieved. Next a full correction was tried for close work and the modified correction was used for distant vision. At the time of my first examination I made out an esophoria of 10° . I combined a 4° prism with the sphero-cylinder and advised the

Name, *Muohi* ————— 22 yrs.

No.													
Date,	1896	4	9	15	17	24	28	+6	11	+3	7	8	10
Hyperph, R.		6	7	7	7			4	0	0		0	0
Hyperph, L.						1							
Esophor,	X	12	14	17				17	17	7	9	9	23
Esop. in A.													
Exophor,	6	0											
Exop. in A.													
Abduction,	7	7	7	7				7	7	7	7	7	7
Adduction,	18	18	24	38				40	40	44	44	44	50
Surcum, R.	7	7	7	7				1	1	1	1	1	1
Surcum, L.	—	0						1	1	1	1	1	1
Parallax Test.	Hyperph,	6	6	4	7			0					0
	Esophoria,	0	0					17	17	9	9	9	4
	Exophoria,	0	0										
	Rest Prisms.	6	6	6	6			14	17	7			

Remarks:

study of the imbalance with the view to correcting the error by an operation. The patient declined and sought relief from some of my colleagues, but with no better success. He then returned to me and I unmasked 16° of esophoria and operated on the right eye, correcting 9° , and later upon the left eye, correcting all but 1° . He found immediate relief and for two years used his eyes freely. During a somewhat protracted

absence from my work he suffered a return of all the old symptoms and consulted a most competent oculist who found an esophoria of 14° . This was corrected by an operation. About two years later another relapse occurred and I advanced the abductors, correcting 18° . Three years later there was another protracted attack of asthenopia. He now consulted some one who advised and did another operation; the result of this was not so fortunate for he was left with a right hyperopia and exophoria of 8° $\frac{4^{\circ}}{}$ and had almost constant diplopia. After some months he returned to me for advice. The condition was rather unusual, for in some positions the balance seemed normal when a contraction of the internus would occur and with a jerking sensation the diplopia would develop. This condition I was at a loss to account for until the conjunctival cicatrix made by the last operation was opened when I found the internal rectus completely detached from its superior wing and center of tendon and the lower wing attached to the globe below the normal position. I replaced the muscle to its normal attachment with sutures.

During the past two years I have frequently tested the muscle balance and have found it normal.

The patient now has complete freedom from asthenopia, but is still subject to neurasthenic headaches, as he has been for many years. He is now wearing his full correction for all purposes, and can read and write for two and three hours a day.

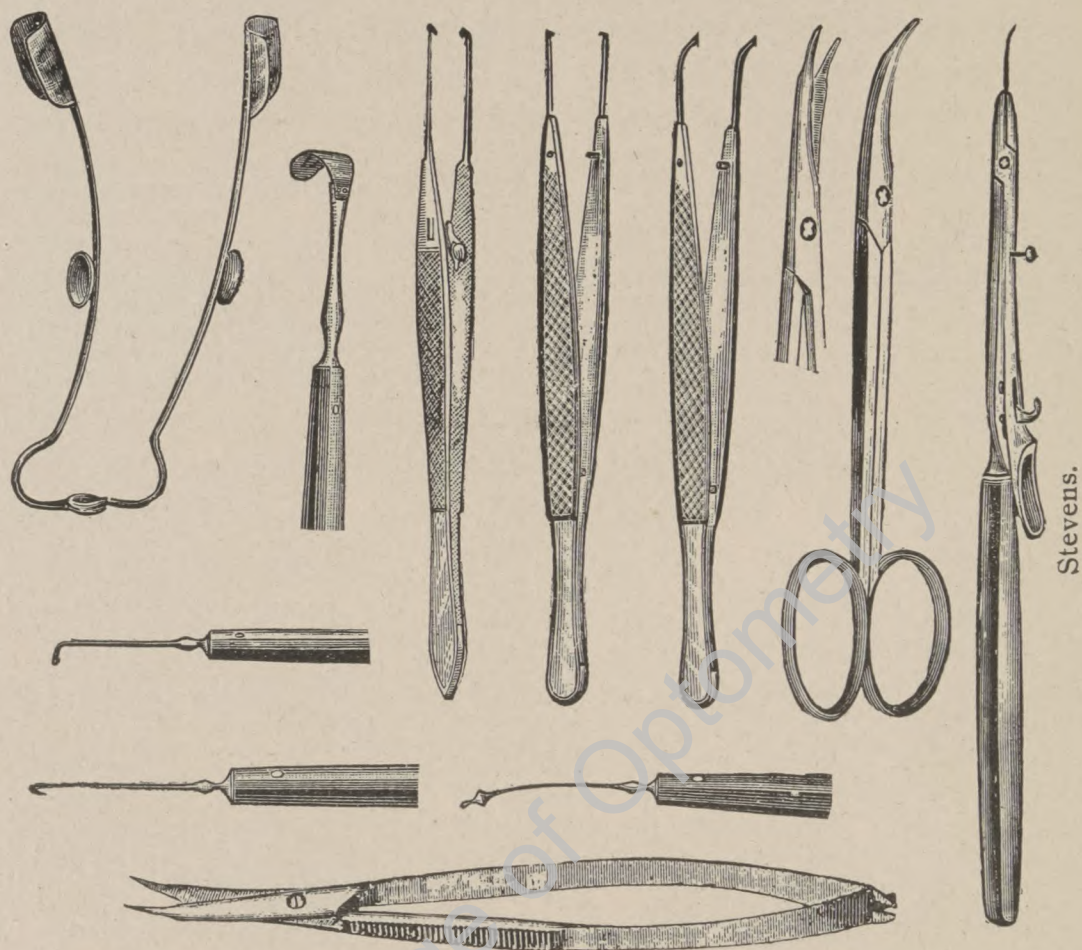
I can explain the return of the esophoria by assuming that the first operations did not correct the error fully and the constant use of the eye produced shortening and contraction from over-stimulation. It was a neuro-muscular relapse.

The operation which caused the hyperphoria may have been properly done, but the superior wing was torn away by a too strong effort of the abductors or adductors.

I desire to impress upon you these deductions from my

experience in the study of many cases of heterophoria and muscular asthenopia.

1st.—Troublesome local and general disturbances may result from imbalance of the ocular muscles.



CHAMBERS, INKREP & CO.—CHICAGO.

FIG. 65.

Instruments used in graduated tenotomy and advancement operations.

2d.—That heterophoria may be one of many causes acting upon the patient, and the removal of one cause of irritation may lessen but not prevent the recurrence of symptoms.

3d.—The correction of the heterophoria may be quickly or slowly followed by a cessation of the symptoms. In this respect the results are always modified by the personal equation of the patient.

4th.—All the other remediable sources of irritation should be cured or removed before attempting the correction of the heterophoria.

5th.—That the study and treatment of muscular imbalance is one of the most difficult problems in practical ophthalmology, and that you cannot be too careful and guarded in prognosis and treatment.

6th.—Local anæsthesia should be employed, cocaine five per cent. solution or holocain two per cent., two drops every three minutes until the conjunctiva is not sensitive to touch; then two drops of 1/10,000 solution of adrenaline chloride (P. D. & Co.) to blanch the tissues and prevent bleeding during the operation.

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CHAPTER VII.

INJURIES, TUMORS AND DISEASES OF THE CONJUNCTIVA.

The conjunctiva, the lining membrane of the lids and cover of the anterior portion of the globe, protects and lubricates the cornea. The lubricating fluid is furnished from two sources, the thick portion from the mucous membrane and its follicles, the thin is secreted by the lachrymal glands.

A free foreign body in the conjunctival sac is soon enveloped by a flake of mucus, and, by the increased flow of secretion from the lachrymal gland, washed toward the internal canthus, and into the minute cilia which stud the little eminence called the caruncle, where it is held until it is floated out upon the integument. Protracted irritation and stimulation of the lachrymal glands causes the tears to become neutral and irritating to the conjunctiva and cornea.

Between the caruncle and the cornea there is a small fold in the conjunctiva, at right angles to the aperture of the lids, called the plica semilunaris; it is analogous to the third lid of many animals.

The lining membrane of the lower lid, which is thrown into folds and crypt-like formations, is abundantly supplied with adenoid tissue. Toward the external canthus there are great numbers of follicles. The fold connecting the tarsal with the ocular conjunctiva is shallow, and, in the normal eye, contains but few follicles and but little adenoid tissue.

The entire ocular conjunctiva is thin, transparent and traversed by a few visible blood vessels; it is almost devoid of

Fig. 1.

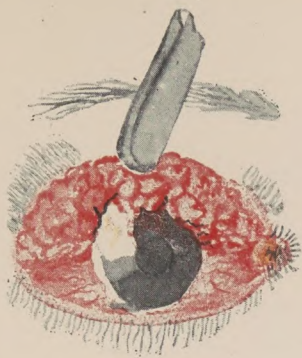


Fig. 5.



Fig. 2.

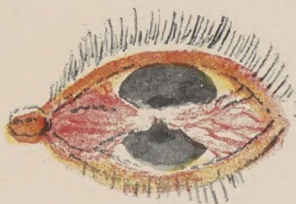


Fig. 6.

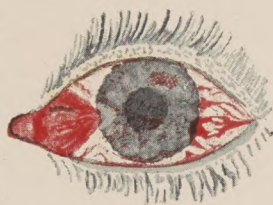


Fig. 3.

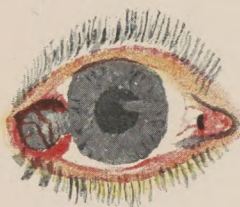


Fig. 7.



Fig. 4.



Fig. 8.

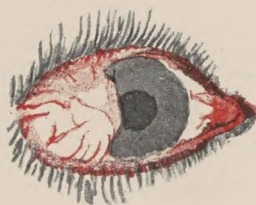


PLATE XIII.

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glandular structures and secretes but little moisture. Anatomically it is like the superficial or epithelial layer of the cornea. Like the cornea it is very sensitive to foreign bodies and quickly responds to irritation.

The upper lid is lined with a membrane identical with that of the lower lid, only containing a greater number of glandular structures, especially toward the outer and inner canthi. It is smoothly attached to the tarsus, and the Mei-

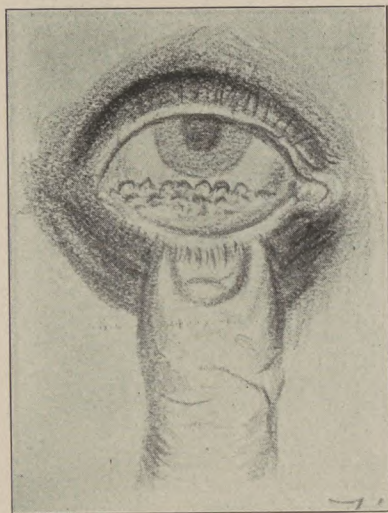


FIG. 66.

bomian glands and ducts are plainly seen through it. The superior retro-tarsal portion is more extensive than the lower, is filled by deep folds and is studded with follicles and sulci. It is dark-red in color and very vascular.

To examine the conjunctiva of the lower lid, its retro-tarsal fold, and the lower portion of the ocular fold. Place the ball of the thumb on the cheek, the tip just even with the margin of the lower lid, press the thumb down and at the same time slightly inward, bidding the patient to direct the eye upward. This maneuver will evert the lid and gradually

expose the retro-tarsal fold. By next directing the patient to look inward or outward the portions at the canthi will be exposed. (Fig. 66.)

To examine the upper lid and its retro-tarsal fold.—Grasp the cilia between the thumb and index finger of the left hand, press the upper margin of the tarsus down with a small probe, at the same time direct the patient to look downward while

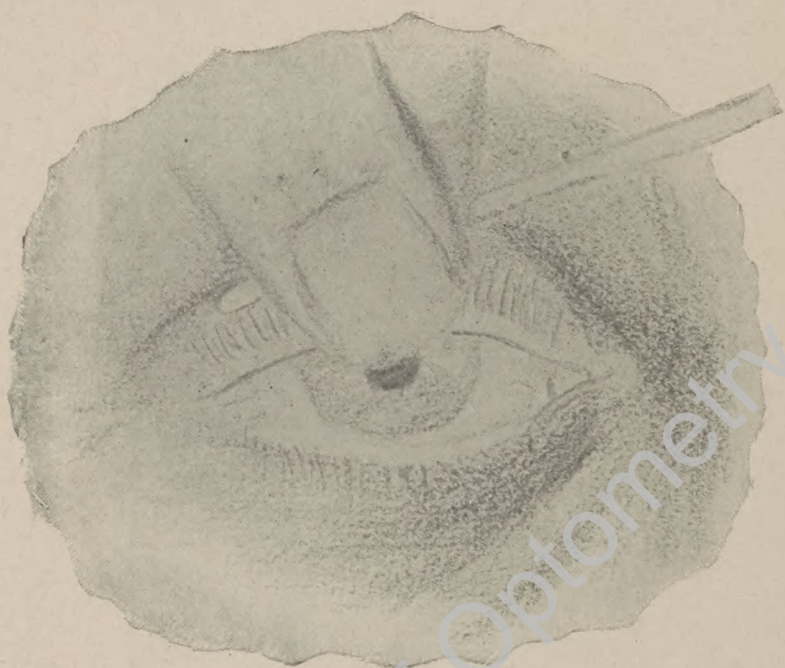


FIG. 67.
Everting the lid.

the operator turns the lid backward and exposes the tarsal conjunctiva. Then with the right thumb and finger, or with forceps, grasp the everted cartilage and roll it backwards upon itself, when the retro-tarsal fold will be exposed. (Fig 67.)

To examine the conjunctiva of an infant, or a refractory child, have an assistant place the child across his lap, holding both feet and hands; place a towel, with the child's head upon it, between your knees. You will now be able to examine the lids, and with lid-retractors examine the cornea and ocular conjunctiva, and make such applications as are required. (Fig. 68.)

Foreign bodies lodged in the conjunctiva or on its surface are the cause of many cases of protracted irritation and initiate sub-acute or chronic catarrhal conditions which favor the lodgement and development of the more specific forms of conjunctivitis.



FIG. 68.

The patient which I present to you to-day gives the following history: About four months ago, Mr. L., aged twenty-six, while engaged in threshing, felt something sharp in his left eye. His fellow-workman examined the eye, but could detect nothing wrong. The irritation at times during the day was severe. That night another search was made without finding

cause to account for the discomfort. The day following there was some excess of lachrymation, and at night a poultice of flaxseed meal was applied, followed by relief from pain, but the discharge continued, becoming somewhat thicker and flaked with pus.

A physician examined the eye, *justly censured the patient for the use of the poultice*, and prescribed a saturated solution of boric acid, applying, himself, a solution of nitrate of silver, (grains 5 to the ounce). The discharge became less but has not disappeared, and the physician refers him to us for examination and treatment. (Plate XIII, Fig. 1.)

I have not yet examined the eye carefully, so we will now inspect and try to determine the cause of the continued discharge and inflammation. The cornea is normal and but slightly lowered in transparency. The ocular conjunctiva is flushed but not highly vascular; the lower lid is red and covered by small, shining granulations (the enlarged mucous follicles), especially marked at the external canthus, and covered by a thick film of mucus in shreds and strings. There are no misdirected lashes; no fault can be found with the drainage of the eye. The upper lid is slightly swollen and œdematous, and especially prominent at the upper edge of the cartilage. Upon eversion we find the mucous membrane red, covered with hypertrophied follicles, and at the margin of the cartilage a large mass of granulation tissue, which bleeds freely and is everted with some difficulty. We next expose the retro-tarsal fold, which seems to be a mass of granulation tissue, and through what seems to be a fistulous opening there is a free discharge of pus. I now introduce a probe and feel a hard substance imbedded in the granulation mass. The probe is used to tear apart the bleeding granulations, and we remove a roundish, flat, quoit-shaped body. It feels like a piece of flint, and on examination proves to be a small pebble about 3 mm. in diameter. I shall crush the granulations between the thumb nails, flush the conjunctiva with $\frac{1}{3000}$ bichloride of mercury, and order cold compress 40° Fahr. applied for

twenty minutes at a time, every three hours, and direct the house physician to flush the conjunctiva every two hours with a saturated solution of boric acid. As soon as the acute symptoms have disappeared, for there will be a reaction from breaking down of the granulations and clearing out of the products of inflammation in the retro-tarsal fold, an application of 10 per cent. solution of protargol should be made once in twelve to twenty-four hours, until the conjunctiva becomes normal and the secretions are free from muco-purulent discharges.

This case should impress you with the importance of a careful examination of all the conjunctival surface, especially the deep folds of the superior fornix. This may be difficult to accomplish, but it can be done. I recall cases in which eye stones, flax seed, broken points of slate and lead pencils, have been allowed to remain in the folds of the conjunctiva and become partly encysted, causing continued and serious inflammation and damage to the eye, and lowered or total loss of vision.

Glass and metal workers are especially liable to injuries of the lids, cornea, and conjunctiva, and it is important that those of you who are brought in contract with this class of cases should be well prepared to examine and treat them skillfully. The equipment for such work is not extensive—a lense of four-inch focus, a probe, a blunt spud, lid retractors, and cilia forceps are necessary.

Cocaine anæsthesia, which is sufficient in cases of recent injury, will enable the operator to make thorough investigation, with but little pain and discomfort to the patient. We have recently added to our list of remedies adrenalin (P. D. & Co.) which thoroughly blanches the conjunctiva of both lids and ocular wall and prevents the flow of blood from a recent injury. The use of this drug will greatly aid in exploring the conjunctiva and its substructures.

This patient, Mr. M. L., a brass-worker, about two hours ago, while at his lathe, felt a sudden stinging blow upon the eye, and with it a blurring of the sight with some bleeding. (Plate XIV, Fig. 4). He comes for examination and treatment. You will observe that the lower outer ocular conjunctiva is dark with extravasated blood, and that the anterior chamber of the eye is red from a recent hæmorrhage into the aqueous. There is a small, clean-cut wound in the conjunctiva about 1 mm. from the sclero-corneal junction. The eye is painful and the tension above normal. Two drops of a 5 per cent. solution of cocaine have been instilled four times in the last fifteen minutes, and two drops of a $\frac{1}{10000}$ solution of adrenalin have just been applied. The bleeding has ceased and the eye is insensible to the touch of the probe.

Upon examining the wound in the conjunctiva I find that the missile struck a glancing blow and has passed backward to the outer canthus. I can with the probe feel the fragment lying upon the tendon of the external rectus muscle, and, on account of the absence of fresh hæmorrhage from the styptic effect of the adrenalin, I am enabled to see it plainly through the slightly enlarged opening of entrance and remove it with the forceps. The fragment is 3 mm. long, 1 mm. broad at its widest part and sharp at both ends. From its peculiar shape and the way in which it struck the eye it did not penetrate the anterior chamber, but glanced outward. The blood in the chamber of the aqueous was the result of the concussion, rupturing the iris just opposite the point of impact. It will be quickly absorbed, but there is some danger that the blow was sufficient to cause ciliary disturbance, for the wound is just over the danger zone. The injury to the conjunctiva and the sub-tissue is a simple matter. We shall be anxious regarding the eye until the blood is absorbed and we are able to examine the deeper parts with the ophthalmoscope and oblique illumination. (Note.—This case is referred to in a later lecture under the head of "*Sympathetic Ophthalmia*.")

This small boy, aged eleven years, was playing with some companions at a "game of ducks." The "duck" in this instance was a beer bottle. Just as this child placed the bottle on the block a playmate threw a stone, striking the bottle and breaking it into many pieces, some of which lodged in the youth's eyes. The left eye is flushed but not infiltrated; the child complains of being pricked as with pins. The accident occurred about four hours ago.

Cocaine anæsthesia is complete, but I cannot see or feel anything sharp, and there is nothing lodged on or in the cornea. The conjunctiva is now blanched with adrenalin. With oblique illumination, and by the aid of a strong lens, I am able to make out two small particles of glass firmly fixed in the sclerotic just beneath the conjunctiva below and to the nasal side of the cornea. In order to be sure of a careful and complete removal of these fragments of glass, chloroform will be administered, for it is not safe to depend upon the child's keeping quiet during the operation for the removal of such a foreign body.

Lacerating wounds of the conjunctiva do not occur frequently where other lid structures are not involved. When such injuries do take place the membrane should be carefully adjusted and sutured into its normal position.

Mr. O. M. was wounded by a knife entering the eye at the external canthus. It severed the external rectus muscle, passed upward and detached the conjunctiva from the globe, cutting the lid obliquely near its inner third. No attempt was made to coaptate the parts, and the result of the injury is a convergent squint with a coloboma of the lid. (Fig. 69).

In order to repair the injury we must advance and re-attach the muscle, freshen the edges of the lid wound, and suture the conjunctival margins together, with fine silk sutures, and the integument with stronger sutures deeply placed.

Burns from hot metal, lime, acids, etc., cause destruction of both cornea and conjunctiva. The pain following such injuries is usually severe and demands prompt relief. Especial attention must also be paid to the burned surfaces to see that the opposing conjunctival walls are kept from union, and that grafts are introduced to prevent the encroachment of the conjunctiva upon the cornea.

Water, with or without boric acid, should be freely and promptly used to irrigate the burned surface; and all particles, if the burn is made by hot metal or lime, should be removed, taking great care to remove the most minute with forceps and irrigation. Cocaine may be of some use to

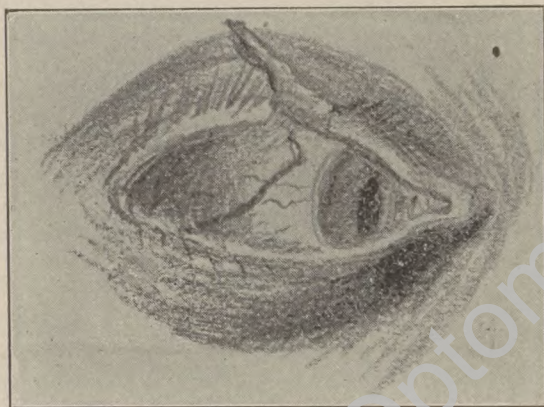


FIG. 69.

produce local anæsthesia, but I have found its effect of little value, and have frequently resorted to general anæsthesia as being the only painless and sure means of allowing thorough cleansing of the surfaces.

Hot lead, unless the quantity be large, does but little harm.

The patient I present to you to-day, a boy of ten years, was assisting in moulding bullets when a quantity of hot lead spattered his face and eyes. The integument is severely burned, but I cannot make out a burn of the cornea. I have had chloroform administered, and we will be able to investigate the conjunctiva and cornea carefully. This substance is a large

thin plaque of lead, almost as large as the lower lid, completely covering the retro-tarsal fold. There is a small eschar near the lower limbus of the cornea, but I cannot see that the conjunctiva has been burned. The moisture was sufficient to prevent it, and the lead, melting as it does with a low degree of heat, quickly cooled. I also find several small fragments of metal in the superior cul-de-sac.

Here is a case of *symblepharon*, the result of a burn from a white-hot swedge of copper. (Plate XIII, Fig. 5.) The injury was received about six months ago, and every effort was made to prevent contraction and adhesion of the wounded surfaces. Mucous grafts were applied at once to the margin of the cornea and a large artificial eye-shell inserted to prevent contact of the palpebral and ocular walls, but without avail. You see the lid firmly grown to the cornea and that the cornea is not covered by the lids. The probe can pass well up into the external cul-de-sac, but at the inner canthus it is firmly adherent. As the burned area is small I shall endeavor to secure enough conjunctiva to cover the globe, and place two mucous grafts, taken from the mouth, to cover the tarsal surface. I have fixed these in position with sutures through the lids. This drawing will illustrate the operation. (Fig. 70.)

(NOTE.—The conjunctival flaps held their positions, the lid grafts both sloughed somewhat, but enough remained to form the nucleus for a cicatrix which causes but little deformity.)

I have found difficulty in obtaining the results to be desired on account of the shrinking and melting away of the mucous grafts. Some of the best results obtained are those in which the skin-graft is taken from the inside of the thighs or arms.

Tumors of the conjunctiva embrace nearly all the forms which may occur to any mucous membrane. They may be

malignant or benign, dermoid or epithelial, hypertrophy of tissues or new growths. (Plate XIII, Fig. 2.)

A double pterygium.—Michael J., a plainsman, sixty years of age, noticed a small, red growth just to the nasal side of the cornea, about six years ago. It gradually extended toward the cornea, broadened on its nasal side, became fleshy and vascular, and was at times painful. The growth encroached upon the cornea and was preceded by a crescentic white line. Two years ago a similar growth developed toward the external canthus and extended inward, meeting at the

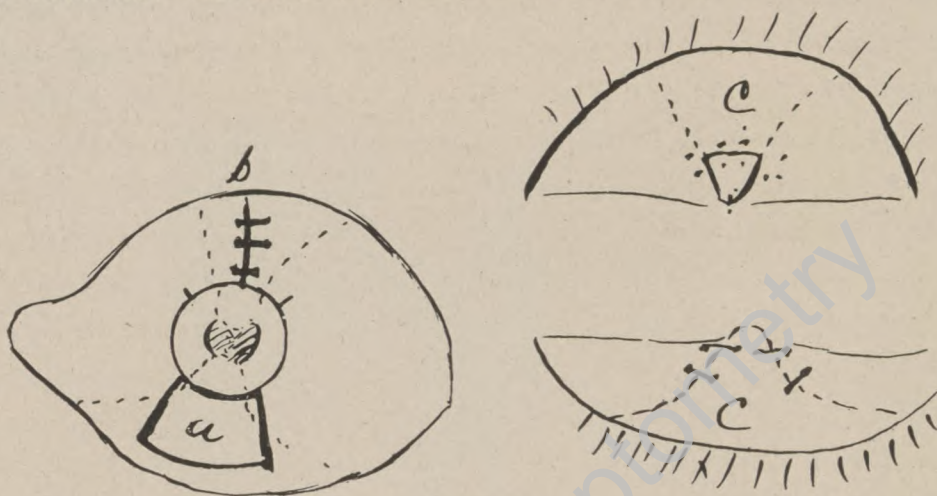


FIG. 70.

Operation to correct deformity, illustrated on Plate XIII, No. 5.

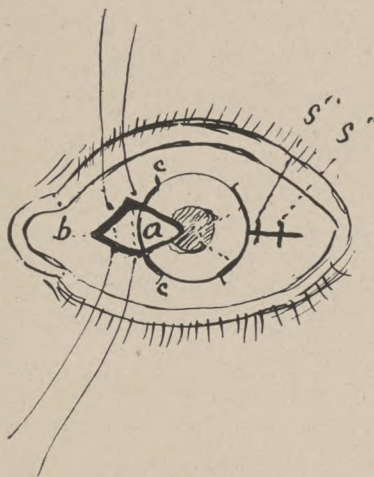
- a. Mucous graft from mouth.
- b. Conjunctiva sutured to cover the area exposed by the removal of the symblepharon.
- c. c. Transplanted flap taken from the ocular wall and attached to tarsus of the upper and lower lids.

centre of the cornea. The vision in that eye is very low, the central and lateral fields being totally obscured. This form of growth is called pterygium.

These tumors are usually of slow growth, they may be thin and but slightly vascular, or thick, fleshy, and beefy-red in color. They frequently occur among laborers and sailors, or those who are exposed to strong light with wind or dust. They should be removed as soon as they show evidence of growth. (Plate XIII, Fig. 6.)

The following operation, has, in my hands at least, proven sufficient. It is simple and requires but little instrumentation.

Cocainize and to prevent hæmorrhage use adrenalin. Place the speculum. Grasp the conjunctival portion of the tumor just at the sclero-corneal junction. Transfix the growth with a Graefé knife or pterygium knife hook (Figs. 71 and 72) and cut toward its apex, dissecting it clean from the cornea.



- a. Head of pterygium.
- a. b. Area uncovered in excising the growth.
- c. c. Line of dissection at the sclero-corneal junction to make the sliding flap which unites with s s to join s' s'.

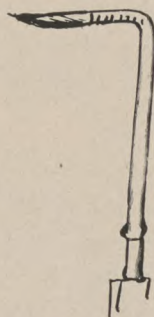


FIG. 72.

Hook knife used in cutting the head of the pterygium.

Next grasp the apex and with the knife separate the conjunctiva from its junction with the cornea and sub-tissue about 3 mm. above and below the growth. Cut off the apex and body of the tumor; introduce two or more fine sutures as indicated in the diagram; before tying remove the speculum. Then close the wound with the sutures, taking care not to draw the thread too tightly, as the conjunctiva is so frail it may cut out and require re-suturing. In the case which we have at hand I have proceeded in the manner just described; I shall, in addition,

sear over the cornea with a galvano-cautery at white-heat. This must be quickly and not too deeply burned. I do this to secure greater corneal transparency than can be expected without the cautery. Should the cornea not become regular, allowing of clear vision, a downward iridectomy can be made. The eye will now be bandaged, and bathed frequently with boric acid solution. The stitches can be removed on the fifth day, the bandages discarded on the second day, only protecting the eye with an eye-shade or protecting mica shield.

The ætiology and pathology of the pterygium is in dispute. I have known it to follow an inflammatory pinguicula, traumatism of the conjunctiva, also to occur in patients who had no history or knowledge of injury or disease. For an extended discussion of the subject I refer you to text-books on ophthalmology.

Epitheliomata of the conjunctiva usually appear upon the margin of the lid just where the skin and mucous membrane blend, and frequently have the appearance of an ulcerating and indurated form of blepharitis. They are of infrequent occurrence, and appear as an indurated area which after a time breaks down, and slowly extends in indolent ulceration. The indurated margin has an irregular ragged outline. All suspicious cases should be investigated with the microscope, and operated as soon as possible—before the lymphatics of the lid become involved. The growth should be removed with a large area of healthy tissue, and the lid repaired at once by skin-grafts and sliding flaps.

Mr. C. H., aged fifty-two years, presented himself at our clinic in 1890 with a ragged, indurated ulcer of the margin of the lid and conjunctiva. I made, at the time, a drawing of the eye to indicate the extent of surface involved. (Plate XIII, Fig. 7.) Microscopic examination confirmed the diagnosis of epithelioma. I removed the entire lower lid and some of the conjunctiva of the orbital wall, and brought a flap from the temple and forehead to replace the removed tissues. (Fig. 73.)

There was one point in the history of this case which to me is interesting. The inside of the flap, on account of the softening and maceration by the tears, became very tender and seemed inclined to ulcerate. I succeeded in planting several grafts from the mouth at various points along this surface, and in four months the inside of the improvised lid became

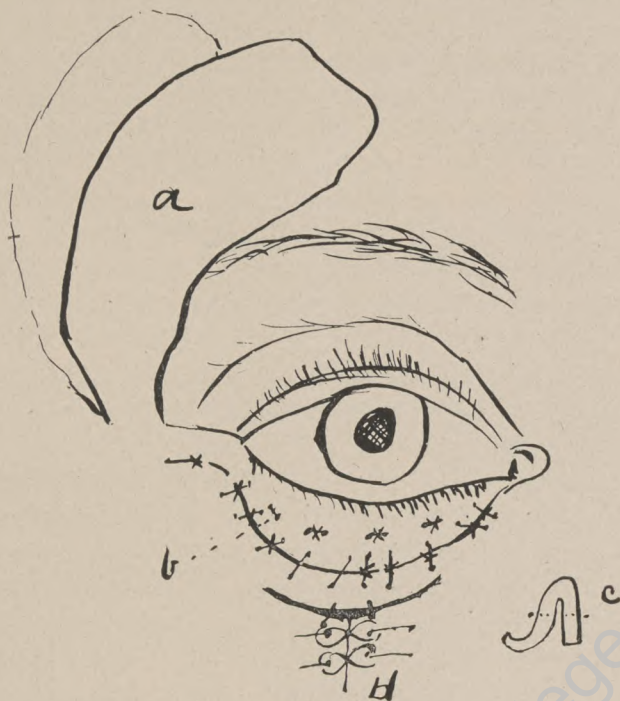


FIG. 73.

Repair of lid after the removal of an epithelioma.

- | | |
|----------------------|------------------------------------------|
| a. Temporal flap. | c. Cross section of flap. |
| b. Flap in position. | a. V-shaped incision converted into a Y. |

almost identical with the mucous membrane. There has been no return of the growth.

Dermoid tumors are not infrequently located at the internal canthus, and in the region of the plica semilunaris. (Plate XIII, Fig. 3.)

This patient, Miss. P., has a small cyst to the corneal side of the conjunctival fold. It has not changed in size for many years. Its location is such that the eye does not close perfectly. It is 5 mm. by 3 mm. and freely movable.

Cocaine has been used, two drops every three minutes, until complete anæsthesia is produced. I grasp the tumor with fixation forceps, and with scissors free it from its attachments, closing the wound with three fine sutures.

The tumor contains about three drops of clear fluid, and three hairs about four inches long, together with some dark pigmented masses.

There are cases reported of dermoids upon the surface of the conjunctiva which do not come under the head of tumors. They are small patches of integument epithelium, sometimes pigmented, with a growth of hairs thickly covering the surface.

Just to the nasal side of the cornea, about midway to the semilunar fold, there is a slight yellow stain in the normal conjunctiva. This discoloration is due to thickening of the conjunctiva and its sub-tissues. It is called a *pinguicula*.

This little body is subject to acute and chronic attacks of inflammation, and may become permanently enlarged and disfiguring. It sometimes seems to be the beginning of what afterwards proves to be a pterygium. At other times it becomes inflamed after exposure to wind or dust; or during attacks of coryza it is red, inflamed, and painful.

The patient before you has been annoyed for four or five years with recurrent attacks of *inflammatory pingui- cula* which has resulted in a tumor of some size. I have advised him to have it excised. It can be done under cocaine anæsthesia. Grasp the tumor with fixation forceps, elevate the growth and excise with curved scissors. Close the wound with one or two fine sutures. Always remove the speculum or lessen the traction upon the lid structures before tying conjunctival su-

tures, for if you do not do so the tension upon the conjunctiva will be too great to allow closure of the wound and the stitch will tear out. It is not necessary to cover the eye, except to exclude dust, following such minor operations upon the conjunctiva.

Cysts of the conjunctiva may occur in any part of the membrane. (Plate XIII, Figs. 4 and 5.)

This case, Miss K., twenty-four years of age. About three years ago she received a small wound upon the ocular membrane, just to the temporal side of the cornea; about four weeks later a small elevation appeared which has continued to increase in size. I can see nothing to indicate that it is other than a sub-conjunctival cyst. The outer membrane moves freely over its surface, and it does not seem to be attached to the globe. With mouse-tooth forceps I elevate the covering membrane and incise it with a Graefé knife and expose a tumor seven mm. by five mm. in its diameter. It is held loosely in the conjunctival tissue, and is easily removed. It contains a clear, slightly viscid fluid and a small particle of flint-like substance which crushes like a bit of glass. I shall not suture the wound, as it does not gape.

It is usually only necessary to puncture the cyst to destroy it, though I have been obliged to inject a 5 per cent. solution of zinc sulphate in recurrent cysts before they would disappear.

Primary sarcoma of the conjunctiva is not of frequent occurrence. The cases coming under my observation have been just at the corneal limbus, and seemed to spring from the cornea rather than from the conjunctiva. (Plate XIV, Fig. 8.)

Mary K., aged nine years, has a small, pigmented growth just at the margin of the cornea. Examination of the deeper parts of the eye does not reveal anything abnormal. When the patient first noticed the tumor it was about the size and

shape of a grain of millet. It is now as large as a small pea; irregular and lobulated in form.

The child is fully anæsthetized, and I shall remove the growth and apply actual cautery over the wound. I shall burn deeply and broadly. The tumor has all the appearance of a pigmented sarcoma. It will be referred to the pathologist for examination. The parents are informed of the grave nature of the tumor, and we shall keep the child under observation for some time, and instruct the parents to report to us at frequent intervals for some years if the child is fortunate to escape so long without a recurrence of the growth.

Should it return I would advise the enucleation of the globe and its ocular conjunctiva, filling the hiatus with a pedunculated flap from the temple, so that an artificial eye can be worn.

Gouty patients are subject to *deposits of lime in the conjunctiva*. The concretions are most abundant in the lower lid and toward the outer canthus. They cause a great amount of irritation and keep the eye in a condition of catarrhal inflammation which does not yield to the usual treatment. Sometimes the little masses are deeply imbedded in the swollen and enlarged papillæ. The extract of suprarenal gland is of use in blanching the tissues, allowing of inspection and investigation.

Mr. T., aged sixty-four, has chronically inflamed and swollen lids. He has gouty joints and atheromatous arteries. The eyes are more painful during an attack of general gout, and the conjunctival symptoms are improved by general treatment. Just now he is not having severe gouty symptoms. Examination of the lids show both to be thickly studded with small, white, sand-like particles in the substance of the lid. They are scattered about in the palpebral membrane, and more thickly massed in the retro-tarsal fold of the lower lid. To remove them I shall instill cocaine freely, and apply a bit

Fig. 1.



Fig. 5.



Fig. 2.



Fig. 6.



Fig. 3.



Fig. 7.

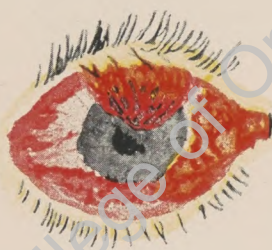


Fig. 4.



Fig. 8.

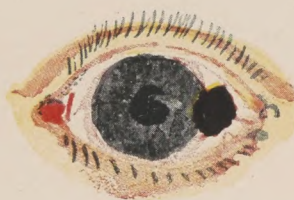


PLATE XIV.

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of lint saturated with it, allowing it to remain in the fold until the anæsthesia is complete. Every two minutes instill one or two drops of adrenalin, for bleeding during the tedious operation for the removal of these minute particles greatly interferes with the work. With the lid under the control of an assistant each grain is quickly picked out with the aid of a lance-pointed knife and a pair of fine forceps. Several sittings will be required to move the accretions; sometimes it is best to allow four or five days to lapse between sittings. Some of the larger masses are so interwoven with the connective tissue it is found difficult, if not impossible, to remove them without excising the mass in which they are imbedded.

Following the removal of these calculi a cold compress should be applied for fifteen or twenty minutes, and the conjunctiva thoroughly flushed with a soda biborate solution, ten grains to the ounce. Twenty-four to forty-eight hours later the lids should again be inspected, when it will be found that the general condition of the conjunctiva has improved, both from the removal of the chalk masses and from the free bleeding which follows the styptic effect of the cocaine and adrenalin.

This patient, Mr. L. H., has a small cyst of the lower lid conjunctiva, near the external canthus. Oblique illumination shows it to be transparent and but slightly vascular. As the pedicle is quite small I tie with a silk ligature and cut it off.

Upon examination I find that it contains a small, round particle about one mm. in diameter, composed of urate of lime, and five minims of clear fluid. The center of the round mass or calculus seems to be a fragment of glass or quartz.

CONJUNCTIVITIS.

The patients we shall study to-day have been selected on account of the condition of their conjunctivas and the compli-

cations which lend special interest. The patients have been arranged to study in series.

Case I.—Mr. L., a chemist's assistant, was working in the laboratory and met with an accident. A bottle of bromine was broken upon the floor and the room filled with its fumes. Closing his nose and mouth he made his way out of the room, but the eyes were irritated by the fumes, and are now in a state of acute hyperæmia. The entire ocular conjunctiva is red, rough, dry and painful. The long arteries and veins are distended and tortuous; the smaller ones, and those usually too minute to be seen, are distended and spiral in appearance. The cornea is gray and dry but not seriously injured. The secretions from the lachrymal gland seem to be drunk up as soon as discharged, and during the last two hours have become exceedingly irritating and painful. The tears have lost their salinity on account of the excessive secretion. The mucous glands and membrane are too much engorged to functionate, hence the eyes feel dry, harsh, and as though full of sand. The cornea must be protected both from the elevated papillæ and the secretion, or the outer layer will be macerated and destroyed. This case presents all the symptoms of conjunctival hyperæmia to an excessive degree. I shall say but a word regarding the treatment of this case, leaving the subject until the discussion of the two cases which follow. To give immediate relief I shall drop into each eye five m. of a $\frac{1}{10000}$ solution of adrenalin chloride and fill the conjunctival sac with an unguent.

R	Soda biborate	gr. xx.
	Vaseline alba	oz. i.

M.

The application can be made every one or two hours, and cold compresses can be applied ten to twenty minutes at a time, following each application of the adrenalin and ointment.

Case II.—This case presents the next step in the history of acute inflammation. Master M., aged seventeen years,

day before yesterday was exposed some hours to a strong wind carrying clouds of dust. Last night the eyes must have been in much the same condition in which we now find Case I, but owing to the large amount of septic matter lodged in and irritating the eye we now find it in the first stage of an acute catarrhal inflammation, which only needs, if it does not already contain them, pathogenic germs to make it purulent, and dangerously so if the gonococci or staphylococci, or others of that class, should find lodgment. (Plate XIV, Fig. 1.)

The cornea is blurred and lustreless, the lashes are matted and thoroughly loaded with partially dried secretions. The lids are thickened, red and œdematous. By exposing the retro-tarsal fold we find the mucous membrane red and abundantly bathed in mucus, which in some parts of the conjunctiva covers it as a thin, grayish pellicle, and in others it is rolled into shreds and ragged strings. The ocular conjunctiva is flushed, of darker pink than Case I, the blood vessels are not as large or tortuous, nor is the area just about the cornea as deep in color as it must have been last night, or as the first case is now.

The retro-tarsal fold of the upper lid is exceedingly darkened, covered by shreds and floating patches of mucus. The eyes are not acutely painful, as they were fifteen hours ago.

Our treatment in this case will be active and directed toward the prevention of serious purulent infection.

The first step is to thoroughly clean the conjunctiva and nasal mucous membrane. I prefer for this purpose the antiseptic, Seiler solution containing 3j of glycerine to the ounce.

I fill a large medicine dropper with the solution at 110° F., expose the superior retro-tarsal fold, flush it out, then the inferior retro-tarsal fold, and later, dilate the punctum, clear out the sac with the Dunn lachrymal syringe, using in all about one ounce of the solution, keeping it hot, and taking care to wash out all the mucous shreds. Second step: Instill a solution of adrenalin and fill the sac with borated vase-

line. If there was any suspicion of specific purulent infection I should apply a twenty per cent. protargol solution over the entire conjunctiva.

The cleaning and anointing of the lids should be done every three or four hours, and a salt solution may be used in the intervals if the symptoms seem to require it.

The point I wish to make is the thorough way in which the cleaning of the conjunctiva should be made. A few drops of antiseptic of the strength we are able to use safely in the eye is of no avail.

The solution should be hot, the quantity sufficient to cleanse, and it should be applied frequently. In irrigating care should be taken not to direct the stream toward the cornea, or in any way irritate it by instruments or handling. Should Case I pass over into the second stage with catarrhal symptoms, the treatment would be the same as suggested for Case II.

Case III.—Our patient, Mary K., is fourteen years of age. Her eyes have been inflamed from early childhood. The lids are thickened, the lashes stunted and thinly scattered along the margin of the lid. The secretion from the Meibomian glands is thick and abundant, the tears are excessive, and epiphora occurs upon exposure to wind, or change of temperature. The drainage ducts are open but not sufficient to carry off the excessive secretion. The nose is irritated by the tears, the lips are thickened and deformed. The mucous membrane is rather pallid in color, not so smooth as normal, and is at times covered by viscid mucus, at others, dry and burning. The cornea is discolored by scars and lowered in lustre by maceration of the epithelium. The mucous papillæ of the retro-tarsal folds are very large, and the sulci deep and extensive. The patient is a mouth-breather; and examination of the throat reveals abundant granulations of the nose and throat. Post-nasal adenoids are common in these cases, and not infrequently the condition of the eyes seems to be dependent upon the condition of the nose and throat, and cannot be

relieved until the adenoid masses have been removed. The condition of the lid, microscopically, is not different from the condition of the pharynx and post-nasal space. The excretory ducts and sac are involved, and the occlusion of lachrymal ducts may be partial or complete. (Plate XIV, Fig. 2.)

The treatment of this class of cases is not materially different from the treatment of the foregoing conditions. We only add to the cleaning and sterilizing of the conjunctiva the



FIG. 74.
Crushing trachoma granulations.

mechanical destruction and stimulation of the adenoid developments in the lid. The manner of emptying the follicles and granulations which are softened and matured enough to permit of destruction, is one which has attracted much attention during the past few years. I shall only attempt to describe treatment which I prefer, and leave the student, who may have interest in the subject, to look over the literature of the topic for other remedies. The method which I employ is

not original, except in that I combine what I deem best of many ways.

Expressing, crushing and massage. I desire to state, in connection with the demonstration of the methods which we employ in the treatment of chronic catarrhal conjunctivitis in this stage of the disease, that the technic is the same as that which I employ in true trachoma.

First step.—Thoroughly irrigate the conjunctival surfaces. Evert the upper lid and expose the retro-tarsal fold. Direct the patient to look downward. (Fig. 74.) Force the thumb



FIG. 75.

Massage of the lids with the thumbs.

of the right hand into the retro-tarsal space and pass the lid between it and the thumb-nail of the left hand. With a stripping, pinching movement crush the granulations, and empty out the softened follicles, and rupture the capsule of the undeveloped masses. Now flush the conjunctiva with a bichloride solution. $\frac{1}{3000}$, and fill the sac with borated vaseline. Apply cold compresses for twenty minutes. Drench the eyes with a saturated solution of boric acid once in two to four hours.

The day following the crushing operation the conjunctiva

will be slightly swollen and covered by a thin pellicle of exudate (Plate XIV, Fig. 6), which can be removed by irrigating with the warm saline solution, 110° F. This treatment by expression is quite painful, but the after-effects are so gratifying that the patients rarely refuse to submit to a second sitting, which should take place in four or five days. Cocaine or holocaine is of little use, and interferes with free bleeding, which is of no little benefit to the lids. Four or more crushing treatments may be required at intervals of three to ten



FIG. 76.

The genesis of trachoma.

- | | |
|------------------|-----------------------------------|
| ? The germ. | c. Mature granulation. |
| a. First stage. | d. Discharging granulation. |
| b. Second stage. | e. Stage of conjunctival atrophy. |

days, with occasional massage, (Fig. 75) rubbing one lid against the other, having previously dusted the palpebral conjunctiva with the amorphous, powdered boric acid, or, if it is desirable to use greater stimulation, stretch a piece of gauze over the index finger and rub the tarsal and retro-tarsal conjunctiva until the engorged papillae bleed freely. Again flush the lids freely with warm boric acid or silver solution, apply vaseline and cold compresses. As the patient improves and the condition of the lids approaches normal, treatment should become less severe, and the massage limited to only the area

involved. For this purpose I use a pair of broad cilia forceps which are strong and flat at their biting part. With these forceps I am able to specialize and destroy the colonies of granulation.

I have used this method of treatment for more than twelve years, and have found it free from the dangers which attend the use of caustics and other chemicals.

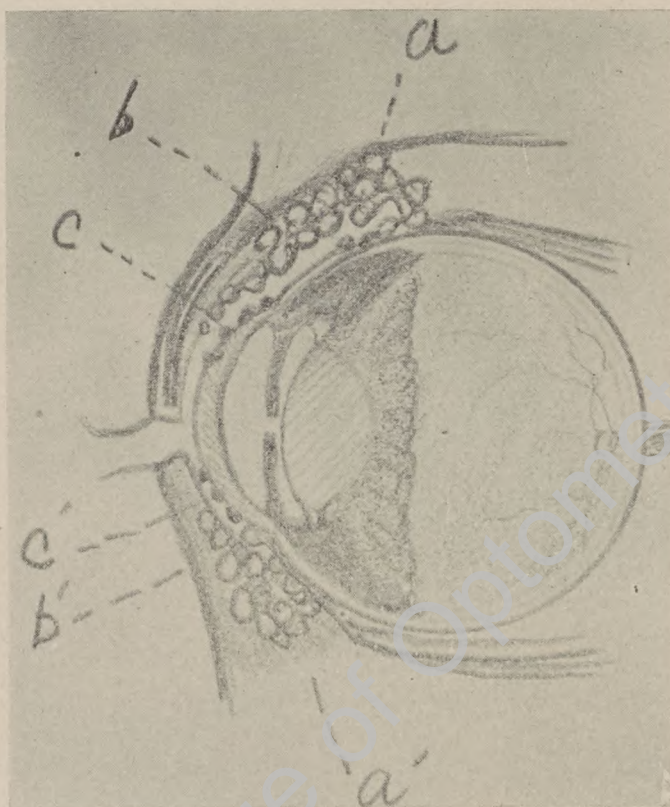


FIG. 77.

- a. a'. Trachoma granulations in retrotarsal fold.
- d. b'. In tarsal fold.
- c. c'. On cornea.

It also has the advantage of greatly shortening the duration of the disease, and preserves the cornea in a much better condition than other forms of treatment, for I have never had corneal ulceration in my cases. There is but little cicatricial contraction, and the after-condition is much to be preferred to that which results from cases treated by other methods; for with the use of silver, copper, zinc, etc., the remaining nor-

mal epithelial surface has acquired the habit of only responding to stimulations of high degree, and without them the secretions of both the lachrymal and mucous glands are not sufficient to prevent the cornea from becoming too dry, and comfortable use of the eyes is impossible.

Our next case is one of *trachoma*, (Plate XIV, Fig. 5.) or specific granulation of the lids.

The disease is widely known as Egyptian ophthalmia.

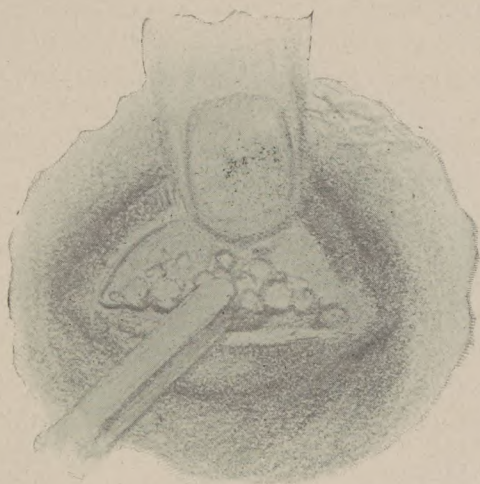


FIG. 78.

Exposing the retrotarsal fold in trachoma.

It has spread to all countries and peoples. The ætiology of the disease is still in dispute, but Fuchs is of the opinion that it is a germ disease, and closely allied to gonorrhœa in its origin, and that the trachoma germ is but a modified gonococcus. However this may be, the history of the formation of a trachoma follicle seems to be as follows: The germ or germs which cause this condition find their way into the conjunctiva, its normal follicles, crypts, or sub-tissues (see Fig. 76), and there forms about the colony a deposit of leucocytes and con-

nective tissue in which they germinate, and, migrating, infect other areas, until the whole conjunctiva is involved, the cornea infiltrated, and mayhaps the deeper parts of the eye concerned. If the disease is allowed to run its course, the destruction of the normal mucous membrane follows, and a condition of atrophy results. (Plate XIV, Fig. 3).

The history of trachoma is one of chronic inflammation of the conjunctiva, with acute exacerbations. The invasion of the disease is slow and insidious, or may be ushered in by an acute attack resembling muco-purulent ophthalmia. Usually the patient simply complains of a thickening of the lids, with ptosis and asthenopia. The secretions are at times increased, at others diminished. Vision is lowered, and the cornea loses its lustre. The lids are glued together in the morning, and the cilia at first grow with unusual rapidity, and later fall out or become stunted.

The undeveloped hair glands in the margin of the lids become active, and a crop of very thin, pale lashes spring up and are directed toward the cornea, causing great irritation, pain, keratitis, and, not infrequently, early corneal ulcers. (Plate XIV, Fig. 7).

At this stage of the disease the eversion of the lower lid sometimes takes place from excessive proliferation of granulations. In the case before us the lid is somewhat inverted resulting from the excessive swelling in the lower cul-de-sac, and the lashes are sweeping the cornea, causing a spasm of the lids and rendering the exposure of the conjunctiva difficult. (Fig. 78.) The granulations of both upper and lower lids are large, rather pale, and easily crushed. The interspaces are dark and congested. The secretions are thick and flaked with pus, the cornea is dull and lustreless, the pericorneal blood vessels are injected and extend far upon the cornea. While we have the granulations exposed I will express them. The resulting contents mingled with the blood from the ruptured vessels look like semi-transparent grains of moist sago. There is free bleeding obscuring the field of

operation, but the sense of touch enables me to go over the entire area, and press out all the softened masses. I now flood the conjunctiva with a saturated solution of boric acid, 110° F., following with a $\frac{1}{1000}$ solution of bichloride of mercury. As soon as the bleeding has ceased remove all the clots of blood and strings of mucus. Fill the conjunctival sac with borated vaseline and direct the patient to bathe the eye for fifteen or twenty minutes with cold water.

(Two days later.) The lids are not as much swollen, the cornea is clearer and less irritable, the conjunctiva is covered



FIG. 79.

The appearance of the closed lids in the early stage of trachoma.

by a thin, smooth pellicle of plastic exudate. This covering I shall leave in place till it is dissolved away, using only the boric acid bath. On the fourth or fifth day it will dissolve, when we will search for and crush any remaining follicles which may have escaped our first operation.

The next step will be to clear these away with the cilia forceps, or to rupture them with a knife needle. Whenever any of the granulations appear they may be crushed and the lids massaged. If the secretions are scant they can be stimulated by the addition of glycerine to the solution used to bathe the lids, or by the application of a zine sulphate solution,

$\frac{1}{200}$, once or twice a day. In chronic cases which have become accustomed to the strong copper and other stimulating solutions, the massage will be required more frequently.

In mixed cases where the papillæ and follicles are hypertrophied the stimulation by friction can be increased by covering the index finger with a pledget of gauze dipped into amorphous boric acid, and rubbing the areas involved.

Corneal ulceration is a frequent occurrence during the progress of trachoma. Superficial inflammation and irritation are almost constant conditions. The periphery of the cornea early becomes vascular, especially at its superior margin; small, whitish, superficial dots appear in the cornea, and the lymphatics and blood-vessels become visible, extending towards them. Extensive erosions of the superficial epithelial layers may involve the entire cornea. (Plate XV, Fig. 1.) Perforating ulceration does not occur with frequency. The cornea may become infected with the specific germ or germs, and pass through the different stages of the disease, the appearance of the infected areas being modified by the tissue in which it is being developed. These infiltrations are slow to clear up when deep and extensive in area. The vascular condition of the cornea in the early stage of the disease is generally due to friction of the lids and later on specific infection.

The treatment of the cornea cannot be separated from the treatment of the general disease of the conjunctiva. Atropia may be used to relieve pain, and borated vaseline to protect the cornea and prevent the lashes from sticking together. Galvano-cautery may be employed in destroying the excessive growth of panus and to sterilize ulcerating surfaces. The general treatment of the lids should be managed as though the ulcers were not.

During the past six months I have been using protonuclein "special" with flattering results. The powder is dusted freely on the everted lids, after they have been first cleansed with hot boric acid solution. The lids are thoroughly mass-

aged and the powder allowed to dissolve and be absorbed or carried into the nose. So far as my experience goes it has proven of great value; the discharge becoming less abundant and non-purulent, the cornea quickly clearing up and becoming less vascular. Hot and cold compresses may be used according to the relief afforded. They should not be used for more than twenty minutes at a time, and not repeated unless they palliate the pain and burning.

Continual corneal irritation may cause iritis or an iridocyclitis with exudate completely blocking the pupil. Atropia should be instilled as soon as the iris becomes involved and continued until it subsides. Atropia, however, must be used with care, as its continued use seems to increase the activity of some forms of conjunctivitis.

The cornea is the most important structure with which we have to deal. It is the structure to be most seriously considered in all treatment directed toward the conjunctival sac in the management of trachoma. Cocaine should be used, if at all, with great care: caustics and stimulants only when seriously needed. For many years I have been able to treat my cases without these remedies, and have had fewer corneal complications than formerly.

Trachoma, or specific granulation, unless recognized in the early stages of the disease, and properly treated, is lifelong in duration. It may be modified by change of environment and improvement in conditions of general health.

Certain sections of the country seem to favor its development and propagation. The dust, wind and exposure on the plains, or confinement in the ill-ventilated, smoky and unhygienic quarters of mining or lumber camps, cause conjunctival irritation and inflammation, which render the eyes susceptible to the trachoma germ. Certain localities in our own state furnish a large percentage of cases which are referred to the Illinois Charitable Eye and Ear Infirmary for treatment.

The case which we have for observation to-day comes from near Cairo, Illinois. Mr. K., aged forty-three years,

has had trachoma from early youth, and has been much treated. Almost his first memory is of blue stone and the caustics. We are chiefly interested, however, in the study of the present condition of the conjunctiva and lids. The palpebral aperture is narrowed, the borders of the lids are covered by stunted lashes which are misdirected and unusually abundant. The lids are curved inward by the contraction of the atrophied conjunctiva. Upon everting the lids the mucous



FIG. 80.

- a. Sequelæ of trachoma; lids incurved, lashes displaced. Cornea scarred and opaque. b. Schematic section of eye and lids.

membrane is found to be almost totally destroyed by protracted inflammation, and its place taken by bands of cicatricial tissue, which draw up the cartilage until it is markedly curved inward, resulting in the destruction of the inner angle of the free border of the lid. (Fig. 80.)

The cornea, from the constant irritation of the trachoma, the incurved lids, misdirected lashes, and infection from the diseased conjunctiva, has become vascular. He has had re-

peated attacks of superficial keratitis and ulceration, frequently threatening perforation. The ocular conjunctiva is thickened, vascular and contracted. The retrotarsal folds are nearly obliterated. Vision is low, $\frac{4}{200}$. We shall attempt to relieve his suffering and improve his condition by a canthoplasty and Hotz operation.

In addition to the regular Hotz operation, I shall attempt to increase the effect by inserting two mucous grafts and holding them in position with sutures, not through the graft but through the lips of the wound at the margin of the lids, the

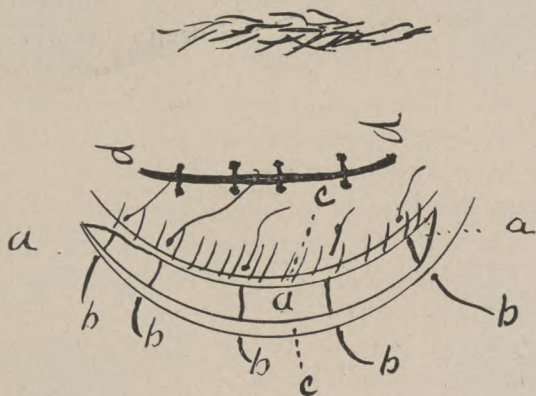


FIG. 81.

- a. a. a. Mucous graft held in position by
- b. b. b. sutures passed through the
- c. c. c. margin of split lid.
- d. d. Hotz operation.

graft being held in position by the pressure of the sutures. (Fig. 81.) A dressing of collodion is applied to the lid wounds and a very light bandage is worn for twelve hours, when the conjunctiva is flushed with warm boric acid solution, and the lids protected by mica shields. It is not safe to keep the eyes bandaged for a longer time on account of the low condition of the nutrition of the cornea. The sutures can be removed on or after the sixth day.

The cornea will improve in transparency as soon as the irritation from the lids has been removed; but should the ci-

catricial tissue and epithelial irregularity remain and prevent useful vision, I shall advise the application of jequirity in the form of an infusion, applied once daily for three days. On the third day the mucous membrane will be covered by a thin film of exudate (Plate XV, Fig. 4) which may extend over the cornea. The fourth day the exudate will become dense as a diphtheritic membrane, and the lids swollen, painful and flooded with tears. On the fifth or sixth day the inflammation will have subsided, and by the tenth or twelfth day the membrane will have exfoliated.

The result as a rule will fully repay the suffering, for the cornea will clear and all but the deep scars will disappear. The effect of the drug seems to extend only to the epithelial layers. Ulceration of the cornea, with extensive destruction, has been reported as a result of the use of the infusion. I have never seen a case, and am inclined to the opinion that the trouble was not the result of the drug applied, but rather of its being applied in an improper case, or that the eyes became infected by other germs than those generated in a normal infusion.

The infusion is made in the following manner: One dram of the freshly ground bean, deprived of its shuck, and three drams of sterile water are placed in a test tube, covered with a plug of absorbent cotton, and allowed to stand twenty-four hours. Evert the eyelids and drop ten minims of the infusion into the eyes, bathing them one hour later with a boric acid or biborate of soda solution, ten grains to the ounce.

Vernal catarrh of the conjunctiva occurs, in certain patients, during the spring and summer months. It may begin in the form of an acute conjunctivitis, or come on slowly and insidiously. (Plate XV, Fig. 8.)

The distinctive feature is an elevation of the epithelium of the pericornea and a papillary conjunctivitis, which extends both to the ocular and palpebral conjunctiva and becomes on the cornea like a non-vascular panus, only it invades the cornea

Fig. 1

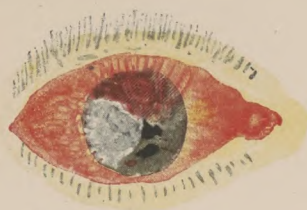


Fig. 5



Fig. 2



Fig. 6



Fig. 3



Fig. 7



Fig. 4



Fig. 8



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from all directions. The conjunctiva is swollen and hyperæmic. The lachrymal secretions are excessive and irritating to the integument. Light is intolerable, the tendency of the patient is to keep the head covered from both light and air; sneezing frequently follows exposure to light.

Little is known regarding the cause of this disease. It seems to be closely related to hay fever, both in history and symptomatology. My experience with the condition leads me to the opinion that the disease is the result of two factors, one systemic and closely allied to improper liver and kidney eliminations; the other, some kind of dust or pollen which irritates the susceptible conjunctiva.

I have proceeded along these lines in treating my recent cases, and have had good results both in relieving and preventing the recurrence of the disease. The cases which I present to you have been under treatment for some days.

Mr. —, aged twenty-three years, came to me about fourteen months ago, suffering from an attack of acute spring catarrh. He had already been afflicted for four or five successive years, the attack beginning each time about the first of June and lasting until September. Last year the attack came the last week in May, and on the third day of June it was in full course.

He was nearly blind with the swelling of the lids and conjunctiva. The cornea and pericornea were covered by a dense film of elevated and hypertrophied epithelium.

An examination of his urine for three successive days gave a sp. gr. of 1008, 1009 and 1008; the reaction was alkaline or neutral; urea low and alkaline phosphates excessive. Stools pale and offensive. Temperature 100° F. The nose was sprayed with Seiler solution every three hours, and the eyes bathed with the same every half hour, and also a solution of formalin $\frac{1}{1000}$ twice daily. Calomel, $\frac{1}{10}$ grain, administered every hour for ten hours each day for three consecutive days, and sodium salicylate fifteen grains with sodium phos-

phate one dram every night for three nights. After the fifth day sodium salicylate, thirty grains, was continued daily for three weeks. Fifteen days after the first visit the eyes were clean and almost free from inflammation. He was then advised to continue the salicylate of soda in combination with quinia sulphate, and to take one grain of calomel in one-tenth grain doses one day in every fifteen. The conjunctiva to be bathed with Seiler solution three or four times a day.

At my request this spring he returns to-day to report his condition. About fifteen days ago having acute symptoms of a return of the trouble, he began at once the treatment which was instituted last year, with the result which you see—viz., a condition strongly in contrast with his former attacks.

He has to-day a slight conjunctivitis, with but little nasal and general disturbance.

The next case is also one of vernal catarrh in the stage of invasion. The first attack occurred about five years ago. He suffered from asthma prior to a protracted residence in Mexico, and on account of this eye trouble he came north five years ago. The attack last year came on about April 1st, while at work in Memphis, Tenn. He has been obliged much of the time to live in the almshouse and hospital. He came to our clinic two weeks ago, in the first stage of the disease. He had at that time been drinking beer freely, and living, most of the time, by begging from door to door and at free-lunch counters. I referred him to the nose and throat clinic for care. We have taken care of the eyes and general condition as in the other case. His eyes are much improved, in spite of the adverse conditions. The cornea is almost obscured by old scars and the recent products of inflammation. The palpebral aperture is much contracted by the protracted spasm and cicatricial contraction. (Plate XV, Fig. 8.) Should we succeed in relieving his condition and he remain under our care until autumn, I shall try the effect of jequirity upon the corneal opacities. A canthoplasty would aid us in

relieving his condition, and as soon as the acute symptoms from the jequirity have subsided I shall operate. I have tried galvano and actual cautery without favorable results.

Phlyctenular conjunctivitis is a condition peculiar to children and youths of scrofulous or strumous diathesis. The glands of the neck are usually infiltrated, the tonsils enlarged and subject to attacks of acute inflammation, the post-nasal space filled with adenoids, the lips and nose thickened and deformed in the characteristic way. The general nutrition is below par, and the patient either very thin or weighed down with abnormal adipose. There are many cases presenting all of the stigmata of hereditary syphilis. Untreated and mis-managed cases recur every winter, and continue until allowed the less unhygienic liberty of the street or vacant lot during the warm months. These cases occur with greater frequency in the poor quarters of the city and among the unclean and vicious poor. The close and ill-ventilated rooms of the tenement houses are the favorite breeding-grounds of the disease, though it does occur in predisposed patients in the homes of the more favorably housed. At this time of year* our clinics are full of these unfortunate children. The disease usually invades the cornea, as well as the ocular conjunctiva, and, if centrally located and if the inflammation passes to the third stage, a small indelible scar is left. Adults are occasionally subject to the phlyctenular disease of the eye, but these cases are rare.

We have in the patients reserved for our study to-day, illustrations of the *three stages of the disease*, their complications and sequelæ. Some of the individual cases present all of the types in a single eye.

The stage of the papule. (Plate XV, Fig. 2.) This patient, Mary —, five years of age, from early infancy has been subject to recurrent attacks of conjunctivitis and kera-

*Late winter and early spring.

titis. She comes to our clinic to-day for the first time. You will observe that her head is held close against her mother's shoulder, and that her eyes are closely bandaged with a dark and not too clean cloth. The head is forcibly withdrawn from the mother's shoulder and the child held in the position for examination. The face and eyes are wet with perspiration and retained secretions. The face is studded with small, red elevations and bleeding scabs. The child struggles to avoid the light.

The nose is blocked with discharge, and the teeth are decayed, irregular and offensive. The lymphatics of the neck are enlarged and tender. The general expression of the face is that of a mouth-breather. Retractors are used to open the lids and expose the conjunctiva. There are several small, red elevations on the conjunctiva, near the cornea, and at its margin. The cornea is gray, macerated and dotted with scars of former attacks of the disease. The papules are in the conjunctival tissue, very vascular, and freely movable. (Plate XV, Figs. 2, 6 and 7.) The general conjunctiva is injected, the superficial vessels large and tortuous and the secretions abundant and acrid.

Clean the nose and throat, flood the eyes with a saturated boric acid solution; instill atropia (two grains to the ounce of distilled water) every two hours; bathe the face with castile soap, and follow with biborate of soda ointment about the eyelids and in the lashes. Administer general alterative and tonic treatment internally with a careful diet. Most children of this class eat at the table and the same food as adults, together with raw and stale fruits between meals, and are subject to attacks of stomach and bowel indigestion. The photophobia is so severe, and the struggles of the child to keep the eyes covered and burrowed in some dark corner, that you will find it a difficult task to keep the patient from increasing and prolonging the trouble by bad breathing, retention of the discharges and secretions. The spasm of the lids, in these

cases, sometimes is so persistent and the closure so perfect, that the lids will fill with a dram or more of acrid secretions. Children who are old enough to be reasoned with can often be persuaded to desist: but with the young child who does not reason and who only seeks to evade suffering, you will be forced to resort to the cold-face plunge, or to tying the hands and strapping the child to a board or chair so that the face cannot be covered. *Bandaging, poulticing, or the use of stimulating or irritating antiseptics, only aggravate the trouble and prevent recovery.*

The second or vesicular stage. The papule has become a vesicle, and is full of turbid fluid which contains various germs and pus-cells.

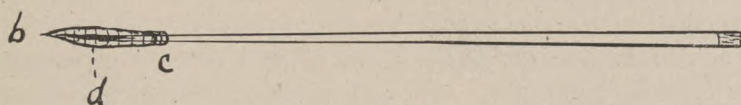


FIG. 82.

- | | |
|--------------------------|------------------------|
| a. A hardwood toothpick. | b. Sharp point. |
| c. Cotton wound band, | d. Line of saturation. |

This patient, George —, aged seven years, has a crop of vesicles in both eyes on cornea and conjunctiva. He is decidedly a strumous child. The eyes and face are involved in an eczematous eruption; about the ears it is confluent. He is over-fat, soft and loggy. We will cauterize the elevations with a small, hard, round cotton carrier dipped in a ninety-five per cent. solution of carbolic acid (Fig. 82).

Take a finely pointed wooden toothpick, wind the point of it with a small bit of absorbent cotton, dip the tip of it into the carbolic acid, and allow about one-third of it to become saturated with the solution, allowing no excess of the acid.

Cocainize the child's eye, or if difficult to control, give chloroform. Introduce a stop speculum, grasp the ocular conjunctiva with a fixation forceps, dry the eye with absorb-

ent cotton, and carefully apply the point to each vesicle, whether it be on the cornea or conjunctiva.

A small, white eschar will appear at each touch. Wash the eye with soda biborate solution and apply a borated vaseline ointment. The subsequent treatment will be the same as in case No. I.

The third, or stage of ulceration, is the most serious stage of the phlyctenular disease, for if the cornea be involved every ulcer will leave a small opacity which may remain through life; and, if central, the scar will interfere with vision; or if the ulcer becomes invaded with pus germs and its specific form changes to pyæmic infection, the result may be disastrous to the eye, for perforation may occur with prolapse of the iris and a possible panophthalmitis.

The next case presents one of the most serious complications that can occur. The patient, Mary L., aged thirteen years, from early childhood has suffered a great part of each year with phlyctenular inflammation of the eyes. On account of a hip disease she has not been able to enjoy active exercise in any form, and has been for a month at a time confined to her room and bed. She first came under my care about one year ago, and had been suffering from a severe muco-purulent conjunctivitis, which had been mistreated. About two weeks prior to her first visit she was attacked with phlyctenular eruptions upon the face and conjunctiva. Her parents were advised to put hot applications on her eyes, and not understanding the danger to the cornea, poulticed her eyes for twenty-four hours with hot potatoes and flaxseed meal. The result was as you would expect, *extensive ulceration of the cornea.*

When she came to the clinic there was a perforation, and prolapse of the iris. The eye was excessively painful, and there was some increase of tension from pus in the anterior chamber. The fellow-eye was studded with phlyctenules

both on the cornea and conjunctiva. The photophobia was extreme.

An anæsthetic was administered, and the anterior chamber of the right eye flushed with a $\frac{1}{2000}$ solution of bichloride of mercury, the prolapsed iris freed, and the prolapsed portion excised. The cornea was cauterized with a ninety-five per cent. solution of carbolic acid, and the vesicles in the fellow-eye were treated the same.

The eyes were cleaned every two or three hours with hot boric acid solution, and atropia one per cent. solution instilled into each eye every four hours. After two weeks of care and much pain, we find the poulticed eye is hopelessly blind; the cornea collapsed and contracted; the iris adherent to the lens; the globe much reduced in size.

The left eye is in fair condition, though the cornea is marked with several scars. I have in this case advised the prompt radical treatment of the tubercular condition, the removal of the infected glands.

I desire to impress upon you the danger of corneal ulceration from the application of a poultice. It should never be used.

Dry or moist heat may be applied, but it should be in the form of an aseptic or antiseptic dressing frequently changed, and as soon as the purpose for which it has been used is accomplished the dressing should be removed.

Ophthalmia Neonatorum.—The conjunctivitis of early infancy usually presents its first symptoms the fourth or fifth day after confinement. The lashes are glued together, and when opened a drop or two of pus or muco-pus is washed out by the excessive flow of tears. The discharge increases rapidly and its purulent character becomes more pronounced. The lids swell and become red and the lashes are matted. There is a spasm of the lids, causing retention of the secretions, and when they are forced open a large quantity of pus and thin, yellow discharge is ejected with a spurt, frequently

endangering the eyes of the examiner unless he is upon his guard.

This child is six days old. The mother was attended by some incompetent person, for on the second day the infant's eyes were observed to be inflamed. Upon the suggestion of some neighbor a poultice of bread and milk was allowed to remain upon the eyes for several hours. The eye-lids, you will observe, are swollen full, and pus is forcing its way through from beneath the distended lids. The pus is cleaned away and the lids gently opened—*very gently*—for we are anxious lest the cornea be already dangerously involved and rough handling might cause a perforation to occur with prolapse of the iris. (Plate XVI, Fig. 1 and 2.)

We find that the cornea is already necrotic in the lower third, and the upper portion is opaque. In the fellow-eye the cornea is only slightly involved—one gray point near its margin. The father admits having had gonorrhœa about three months prior to the birth of the child, so there can be no doubt as to the cause, or form of the infection. These cases are almost invariably directly traceable to specific infection. I have seen many cases, and do not now recall one in which gonorrhœa was not the cause of the trouble, though the poultice in this case was the important factor in hastening the disease. It may be caused by contact with the vaginal discharges during birth, or by the hand of an infected midwife or nurse after birth.

The vagina of the mother should be thoroughly irrigated for days before the confinement, and care should be taken that every instrument, cloth and hand coming in contact with the child is aseptic. After delivery the eyes should be cleaned with a warm boric acid solution, and if there is suspicion of disease in the mother, the eyes should be treated to a fifteen per cent. solution of protargol. Should any signs of conjunctivitis occur, the discharge should be examined with a

Fig. 1



Fig. 3

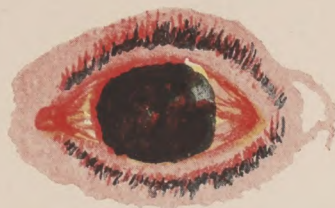


Fig. 2

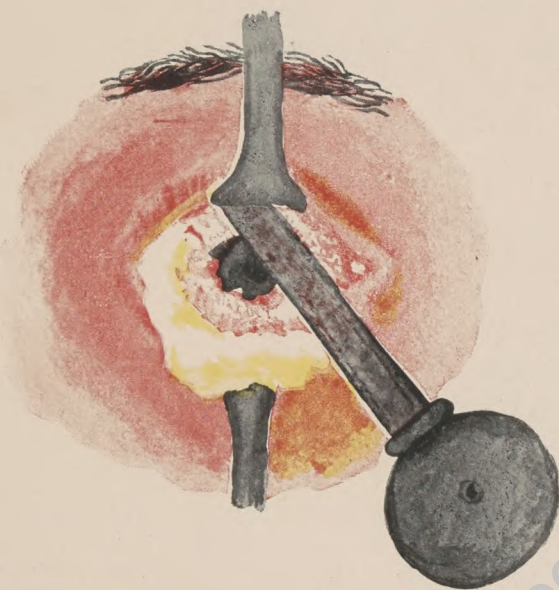


Fig. 4



PLATE XVI.

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microscope. Gonococci being found present, the following treatment should be established at once:

The eyelids and face of the child should be anointed with borated vaseline, the lids opened and held apart with retractors, then drenched with a solution of hydrogen peroxide one part and water three parts. Use a warm solution of boric acid, freely cleanse the eye of shreds of mucus and pus, fill the conjunctiva with borated vaseline and soda biborate, twenty grains to the ounce. This dressing should be made every three hours, and the eyes should be cleansed every hour or half hour with the boric acid solution, if need be, to keep free from pus. This frequent cleansing should be kept up

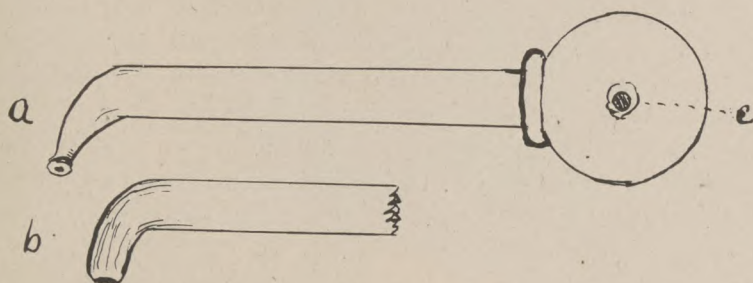


FIG. 83.

- a. Medicine dropper for fluids. b. Tip used for vasaline.
c. Vent hole in bulb!

until the discharge is reduced. Care should always be taken not to irritate the cornea in any way. I have not used silver in these cases for many years and see no reason why it should be used. The danger of corneal ulceration in cases treated early is very small, and the duration of the disease from seven to fifteen days.

Marasmic children are the most liable to corneal complications. The case before us will not receive the care its urgency demands. The visiting nurse will see the child once a day, and she will be treated at the clinic once a day. The mother, with such help as she can secure, will be obliged to attend to the cleaning.

I desire to call your attention to the *method used in cleaning with the boric acid and hydrogen peroxide solutions*. I have found it best to use a medicine-dropper with a large bulb and a curved smooth tip (see Fig. 83). This can be introduced, the heel of the tip first, carefully avoiding contact with the cornea. The instrument is then pressed up as far as it will go and the fluid slowly ejected as it is carried from one portion of the retrotarsal fold to another. The solutions retained are then gently massaged out from the folds, and the final dressing of warm borated vaseline injected with an ointment-carrier (Plate XVI, Fig. 2) and the retrotarsal space filled. Atropia may be used if there is a central ulcer threatening perforation, and eserine if the ulcer is nearer the limbus.

Should the anterior layers of the cornea be destroyed by ulceration, and the deeper layers bulge forward and form an anterior staphyloma or hernia of the inner limiting membrane of the cornea, it may be best to drench the eye with $\frac{1}{2000}$ bi-chloride solution, and with a small needle knife allow the aqueous to escape slowly, taking care not to wound the iris or lens. In this way it may be possible to prevent a prolapse of the iris and the anterior synechia.

The child on whom we shall operate to-day is six years old. He had ophthalmia neonatorum and lost the right eye by a panophthalmitis; the left was blinded by a perforating ulcer of the cornea and a prolapse of the iris. The central scar fills the center of the cornea, and the iris is gathered into it.

The child is totally blind, although he has some slight sensation when a strong light is flashed in front of the eye. I shall do an iridectomy on the upper part of the iris, as the cornea is quite clear and regular at this point.* (Fig. 84.)

Purulent ophthalmia, whether in the child or adult, is the

*The result of the operation was all that could be expected. The child is able to see, and after inspecting objects feels of them to learn what they are. He may have useful vision.

principal cause of the non-congenital blindness that fills our asylums, schools for the blind and almshouses with its victims. Ignorance of the dangers attending a gonorrhœal infection renders people careless in their habits; for this infection is not confined alone to the poor and vicious. The physician who attends a case of gonorrhœa is not doing his entire duty until he has warned the patient regarding the full dangers attending the disease both to himself and others. It cannot be too strongly stated.

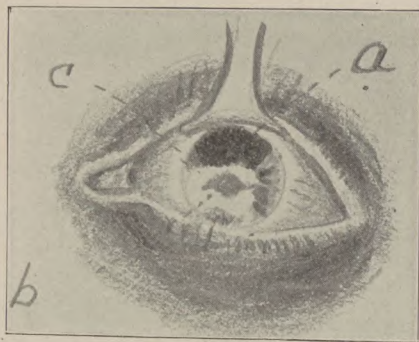


FIG. 84.

Sequelæ of ophthalmia neonatorum, corneal ulcer, prolapse of iris and blindness.

- a. Iridectomy made in clear portion of cornea.
- b. Anterior adhesion of prolapsed portion of iris.
- c. Corneal scar.

The case before us to-day is a male, seventeen years of age. He contracted urethral gonorrhœa about three weeks ago, and the day before yesterday first noticed that the left eye was red, burning, dry and painful. Yesterday there was a free flow of pus, and to-day the lids are swollen full. There is a thick, creamy discharge of pus and thin, yellowish fluid which comes in gushes.

The cornea is clean. The ocular conjunctiva is œdematous and overhangs the cornea. The palpebral conjunctiva is swollen and the papillæ enlarged. The fellow-eye has not become infected. The treatment of this case will be—first,

to seal the right eye with a transparent celluloid cover held in place with collodion or surgeon's plaster.

Take a piece of transparent celluloid, put it into hot water and mould it into the desired form. Trace the outline on which it is to rest with a narrow tape held in position with collodion or surgeon's plaster. Apply the shield and cover it with another strip of cotton held in place with collodion or adhesive plaster. (Fig. 85.) The outer surface of the lids



FIG. 85.

Gonorrhœal ophthalmia the fifth day. The left eye is protected by a celluloid shield.

of the infected eye, after being cleaned with peroxide of hydrogen, is smeared with vaseline.

The lid retractors are applied and hydrogen peroxide one part and water three parts is freely used with the conjunctival syringe, the tip of which is carried into the retrotarsal fold. Next flush out with a saturated solution of boric acid or Seiler solution. Clean the eye of all shreds of mucus and with the vaseline carrier fill the sac with the warm borated vaseline. This dressing should be repeated once in from four to six hours, night and day, and the patient or nurse directed to

separate the lids every half hour and clean out any accumulated discharge.* All dressings should be burned as soon as removed, and every care taken to prevent infection of other parts. The attendants should see that their hands are free from superficial wounds or abrasions, or, if they exist, that they are cauterized with silver nitrate solution, forty grains to the ounce, or with the pure stick. Rubber gloves should be worn when available, and a nurse caring for a gonorrhœal case should not be allowed to attend surgical clinics.

The prognosis in specific disease or purulent ophthalmia, is always grave. A case seen during the first twelve or twenty-four hours after the infection may be aborted. I recall the case of a physician who, while treating a gonorrhœa in a female, absentmindedly rubbed his eye with his finger. Almost instantly he realized what had occurred and the danger it entailed. He at once washed his eyes with hot boric acid, $\frac{1}{1000}$ bichloride, and later had a colleague apply a two per cent. solution of silver nitrate. The eyes were flushed and somewhat irritated by this treatment, but the next morning, or about fourteen hours later, the eyes were clean and free from irritation. During the second night they became painful, dry and burning. At 4 a. m., he called upon me, when I found the eye presenting all the symptoms of infection. The conjunctiva was brick-red and the conjunctival blood-vessels tortuous, especially over the globe, with small flakes of pus floating about through the tears. Toward the external canthus in the lower retrotarsal fold there were two or three areas more deeply engorged than elsewhere. Some of the discharge was put on a slide for future inspection, and I at once applied to the conjunctiva a solution of tincture of iodine

*On the fourteenth day a small corneal ulcer occurred, due to the pressure of the oedematous conjunctiva. No special attention was given the ulcer; care was taken, however, to prevent the retention of discharges beneath the fold. The patient was discharged the twentieth day with but a small corneal scar and a papillary conjunctivitis, the result of the specific disease.

one part, glycerin two parts, taking care that there was no excess of solution on the cotton carrier. The cornea was carefully guarded by my assistant to prevent the solution from coming in contact with it. The retrotarsal fold was carefully mopped out, and ice compresses were applied for four hours. (Should the tension of the lids become too great, the outer canthus can be split as in canthoplasty and the cut surface cauterized with thirty-three per cent. solution of nitrate of silver.)

Frequent microscopic examinations of the secretions were made. In the first specimen there was an abundance of the gonococci of Neisser, in the second but few, and in the last three none. The recovery was rapid and without relapse. While there was some conjunctivitis the specific form only lasted about eight hours after the first application of the iodine solution. This and one other are the only cases seen by me soon enough to have abortive measures avail.

Nitrate of silver, twenty to forty grains to the ounce of water, could have been used in place of the iodine solution.

I have been satisfied with the use of the peroxide of hydrogen, hot boric acid solution and the borated vaseline in the cases coming under my care after the disease was well under way.

In neglected or virulent cases when the cornea is attacked early in the disease, I have paid but little attention to the ulcers of either the cornea or conjunctiva, but insist upon thorough, frequent and careful attention. When the destruction of tissue is considerable I have used the galvano-cautery to the cornea, and perforated at a point as far from the center as was practicable, allowing a slow discharge of aqueous, taking care not to touch the iris. After the cornea is collapsed, sear over the scar and dress as before with borated vaseline. (Note—Corneal sequelæ are considered in the lectures on "Diseases of the Cornea.")

In pink-eye, la grippe, hay fever, and any of the eruptive fevers, the conjunctiva is subject to acute forms of inflammation, differing very little in appearance and history. Weeks, Hansell, Gifford, and others have found that there are specific forms of infection in which certain bacilli and pneumococci are found to which they seem to be due. For pure cultures have been produced and inoculations made, causing a typical disease which in turn has been transmitted to other eyes. I have found in some cases that a solution of formalin $\frac{1}{2000}$ is almost a specific. In severe cases I have applied a solution of $\frac{1}{500}$, being careful to protect the cornea from contact with the solution, cleansing with the soda biborate solution.

In the case of acute conjunctivitis occurring in city-dwellers who are not accustomed to open-air life, I have found that sulphate of zinc, one per cent. solution, five drops in the eye three times a day, affords prompt relief. As a prophylactic I advise the hunter or fisherman to use an eye-cup or bath of soda biborate saturated solution, morning and evening, until the eyes are accustomed to exposure.

The conjunctiva is liable to the specific infection of syphilis, and the primary sore may be the result of the kiss of the parent, lover, or friend, or of the practice of the lower classes of removing a foreign body from the eye with the tongue or applying the saliva to an inflamed eye with the same organ.

Great care should be taken in the differential diagnosis of persistent ulcers of the lids or conjunctiva. When in doubt, before resorting to the knife or destroying with caustics or cautery, administer mercury and the iodides and eliminate syphilis as the possible cause. Syphilitic ulcers should never be destroyed by caustics, for they only return in a more aggravated form. The mucous patches of syphilis may occur upon the conjunctiva.

The sclerotic coat of the eye is not liable to independent inflammation or disease, though malignant tumors, simple cysts and inflammatory conditions do occur.

This young man is referred to us by Professor Smith, of the surgical clinic. There is a tumor occupying the temporal side of the sclera of the right eye. It invades the cornea about five mm. (Fig. 86). About five years ago the young man was wounded by a sharp instrument near the center of the cornea. Three years ago his parents first noticed a small



FIG. 86.

elevation on the sclera about midway to the canthus. It has increased slowly in size. The tumor lies beneath the conjunctiva, which moves freely over it. The growth is fixed to the sclerotic, but does not seem to be connected with the cavity of the eye. The mass is semi-transparent, regular in form and fluctuating. The conjunctiva is opened and the outer

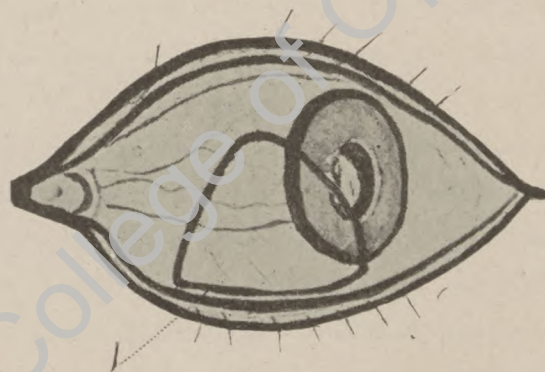


FIG. 87.

wall uncovered. The fluid contents of the tumor will be carefully saved and examined. Nothing is found to indicate the cause of the cyst. It may have been caused by a foreign body which has become disintegrated and absorbed, or by a cysticercus. The next step in the operation is the removal of the

outer wall. (Fig. 87.) This has been done and the surface curetted; the conjunctiva is closed.*

Episcleritis.—This young woman is twenty years of age and has been subject to attacks of circumscribed inflammation of the sclera. There is now on each eye, just below the insertion of the internal recti muscle, a deep-red area of inflammation, very tender to pressure. It is slightly elevated, the conjunctiva can be moved over it, and the color does not disappear with pressure. There are dark, discolored areas in other parts of the sclera, the site of former attacks. (Plate XV. Fig. 4.

Such conditions most frequently occur in strumous and rheumatic patients; may occur in syphilitics; occurs almost always in youths and adults.

Phlyctenula, which it somewhat resembles, develops almost always in babes, and young children before the age of puberty.

I know of no specific. Local treatment is of no avail, unless adrenalin should prove of benefit.

This case is pronouncedly anæmic and rheumatic or lithæmic. I shall advise rest of accommodation, with atropia and dark glasses, a generous vegetable and milk diet, with sodium iodide and salicylates. Also fifteen-minute applications of dry heat every four hours. In other cases I have tried subconjunctival injections of bichloride of mercury, $\frac{1}{1000}$, the common salt solution and scarification of the involved area, without adequate results.

The first attacks may yield quickly to any sedative treatment, but chronic cases are not so tractable and often the most that can be done is palliative. In some of the chronic cases the cornea becomes involved, nebulous infiltrations taking place in the true corneal tissue. The sclera becomes thin and the tension of the eye low and accommodation impaired. Asthenopia is always a marked symptom in the chronic or subacute cases.

One of my chronic cases has been greatly benefited by a protracted residence in Honolulu.

The case recovered quickly and after a lapse of several years shows no signs of a return of the disease.

CHAPTER VIII.

DISEASES OF THE CORNEA, IRIS AND UVEAL TRACT.

Examination of the cornea, iris, chamber of the aqueous and the anterior portion of the lens can be made in two ways.

The oblique illumination method requires the use of a convex lens of about eighteen dioptries (Fig. 88) and a lens attached to a head-band (Fig. 89). Place the patient about eighteen inches distant from a strong light, to the right of it. Hold the patient's lids apart with the left hand and focus the light, with the condenser held in the right hand, upon the cornea. The head-band lens being in position the examiner is now able to search the surface of the cornea for foreign bodies, ulcers, abrasions or minute changes either old or new. In the same manner the iris and anterior portion of the lens can be studied.

To take the tension or palpate for tenderness, direct the patient to close the lids and look downward; place both your index fingers upon the lids and make alternating pressure; the tension will be indicated by the amount of fluctuation felt and can be compared with your own, and other's, eyes if you are in doubt as to the relative condition. In glaucoma the tension becomes high and can be indicated by plus 1, 2 or 3 and so on. Loss of the humors of the eye, either from disease or injury, causes the eye to become soft. This can be indicated in your records by minus 1, 2, 3.

The sensitiveness of the cornea can be estimated by touching it with a bit of soft cotton wound on a probe or cotton-carrier. In glaucoma and some of the later stages of

choroidal disease when the tension is persistently high, or in paralysis, the cornea becomes insensible to touch. You should make a thorough study of normal eyes with all of their modifications, congenital and acquired, always remembering that age lessens the transparency of the media and the mobility of the structures.

Ophthalmoscope.—To master the ophthalmoscope requires years of study and practice. You can, however, in a short time acquire a handling that will be a great aid to you in your practice. Any simple instrument with a few lenses in a



FIG. 88.

revolving disk will answer your purpose. The one lately devised by Dr. Pusey will be found to answer all of the requirements. The mastery of the instrument is the chief thing. The beginner should acquire a certain degree of control of the instrument by practicing upon the schematic eye before attempting to examine the human eye. I shall assume that you have done this dark-room work.

To examine with the ophthalmoscope by the *direct method*, the patient should be in a darkened room sitting in front and to one side of a strong light, a student lamp, argand burner, or a modified electric light of eight candle power. The examiner should sit in front of the patient and begin the examination from about one meter distance. The ligh

thrown upon the cornea allows an inspection of its transparency. The head is approached nearer and nearer to the patient's eye and the cornea and iris and lens inspected and, if needs be, the stronger plus lenses in the ophthalmoscope may be used to obtain a clearer magnified image. The anterior portion of the eye having been examined the deeper portions can be brought into view by revolving the disk to the aperture, the head close to the patient, the red reflex first

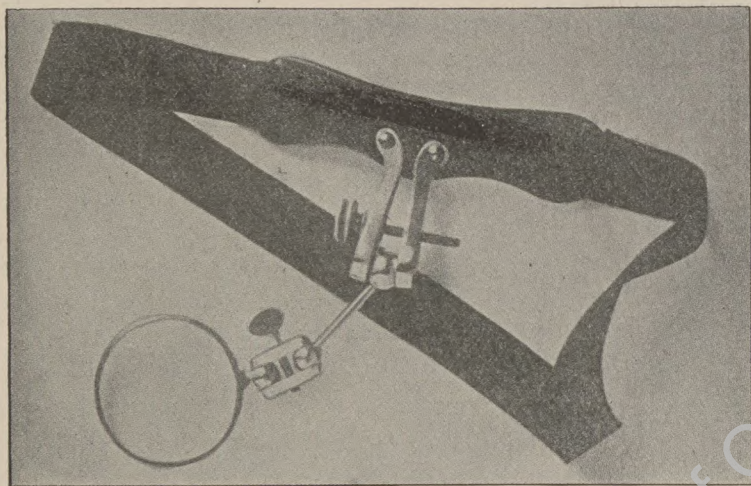


FIG. 89.

seen and as the head is adjusted and the required lens turned into position the fundus, with its details, is made out. In order to acquire a ready handling every case at your command should be examined and studied, not merely to see the fundus but to get its characteristics thoroughly impressed upon your memory, for the physiological and congenital modifications are nearly as varied as the pathological. You should make drawings of such cases in pencil or color and in that way fix the ophthalmoscopic picture in your memory.

Indirect Method.—The image seen by this method is small and inverted and covers a much larger area. It is used

chiefly to secure an accurate impression of the relation of retinal changes to each other, and to the disk, and to arrive at tonal quality of the disk. It is useful for arriving at the size of large lesions, tumors, choroidal ruptures, extensive retinal hæmorrhages and retinal detachments. The position of the examiner is the one first assumed in making the direct examination, with the exception that a plus 7D lens is placed about four inches from the patient's eye and the lens and head of the examiner are adjusted to receive a picture of the retina. You can now, by revolving the lens in the disk of the ophthalmoscope, obtain better definition and by directing the patient's gaze up or down, in or out, search the entire field. After learning to handle the instrument it needs but little practice to keep its mastery.

The *cornea* is the most important structure of the eye to which we have free access. (Plate XVII, a, b, c, d, e.) The epithelial layer, with its limiting membrane, is subject to injury and irritation. Particles of dust, minute bits of emery, steel, or other substances may find lodgement in or on the cornea. Superficial fragments may be removed from the cornea with a bit of cotton wound on a carrier. Those but slightly imbedded should be removed with a dull spud. This requires a steady hand, a light touch, and above all a perfectly clean instrument. (Should your patient be refractory or nervous cocaine should be instilled.) Have an assistant hold the eyelids apart and steady the head, when you have located the foreign body grasp the conjunctiva with fixation forceps to hold the eye quiet and with accurate touch remove the particle, being careful not to remove unnecessary epithelium. The eye should then be bathed with a saturated solution of boric acid and it should not be bandaged.

This patient, Mr. R., a metal-worker, while at his lathe yesterday was wounded by a fragment which gave him a sharp blow in the eye and for a time caused him a slight pain. His

foreman, who is quite expert in removing foreign bodies of this kind, examined his eye and assured him that the object did not lodge in the eye, but that he could see the wound of impact. During the rest of the day he did not suffer much, but by midnight the pain was severe and a hot poultice was applied. The patient fell asleep and the poultice of sour bread and milk was allowed to remain for about six hours. He awoke some three hours ago in severe pain. The conjunctiva is bathed in flocculent mucus and is very red; the cornea is gray and roughened. Just below the center of the

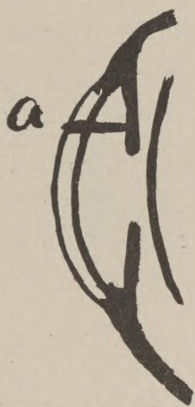


FIG. 90.
F. B. Iris and cornea.

moderately dilated pupil in the iris there is a small hæmorrhage, and externally the cornea is roughened. (Fig. 90 a.) With oblique illumination I can make out a minute metal point just in the corneal wound and a fine, wire-like line of metal projecting into the anterior chamber. The part projecting is too small to grasp with the forceps and I dare not touch it lest it be forced inwards and fall into the anterior chamber. I shall attempt its removal with a McIntosh galvanomagnet. Contact is made and with slight lateral movement the spicula of steel is slowly withdrawn; there following a slight gush of aqueous. The eye is again thoroughly

cleansed with boric acid solution. Atropine sulphate is instilled, and rest of the eye enjoined. I shall not apply a bandage.

This eye is in a most dangerous condition, a perforating corneal wound, and a septic conjunctival sac due to the poultice.

The after-treatment will consist of hourly flushing with hot boric acid solution and if the wound seems inclined to suppurate I shall use the cautery.

Master T., aged seven years, an hour ago received a wound from a stick top, the iron point entered the cornea

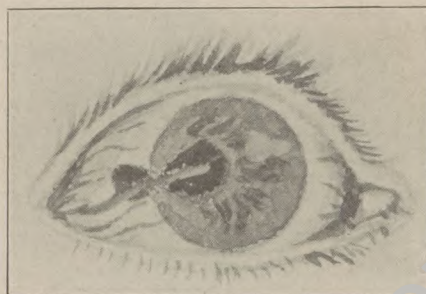
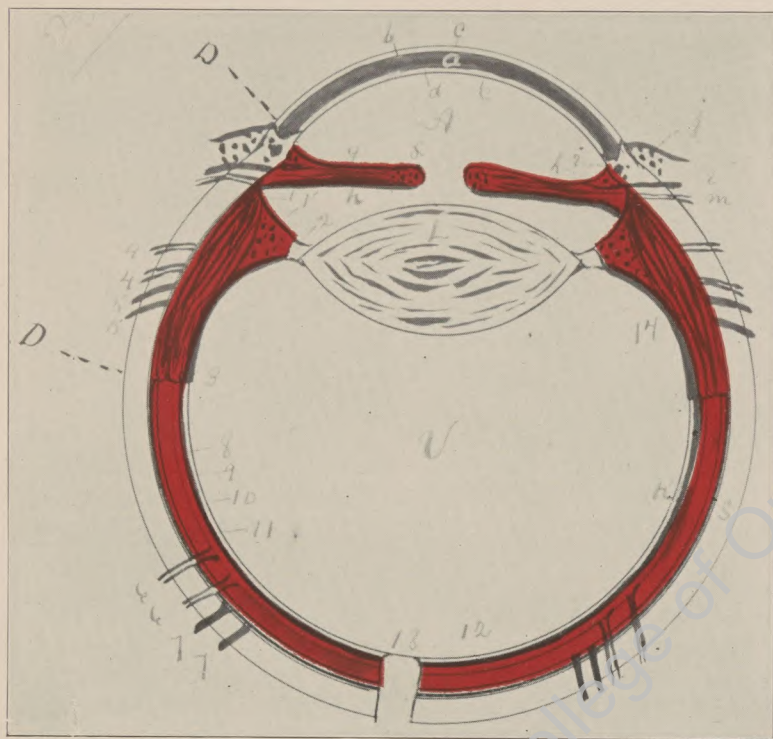


FIG. 91.
Prolapse of iris.

(Fig. 91) just to the temporal side. The cut is about five mm. long, the iris prolapsed into it, and the anterior chamber discharging aqueous through the folds of the dislocated iris. The iris was not cut for there has been no bleeding. The top struck a glancing blow, for there is a contusion on the cheek. I cannot make out the lens but suspect that it has not been wounded. I shall use cocaine, dress back the prolapsed iris, close the cornea with a suture, instill atropia and apply a borated gauze dressing. The stick top was new and clean, having been used on a recently laid wooden sidewalk. The iris could not have come into contact with the spike and in its prolapse came only in contact with the aqueous. It did not project through the cornea and only required slight manipulation to allow it to fall into position. Had it been pro-



SCHEMATIC DRAWING OF THE EYE.

PLATE XVII.

- (a) True corneal substance, or *substantia propria*.
- (b) Anterior limiting membrane, or Bowman's membrane.
- (c) Conjunctival epithelium.
- (d) Posterior limiting membrane, or Descemet's membrane.
- (e) Posterior epithelium, or endothelial layer.
- (j) Pericorneal lymphatics.
- (i) Canal of Schlemm.
- (k) Spaces of Fontana.
- (l) Anterior ciliary vein supplying iris.
- (m) Anterior ciliary artery supplying the iris.
- (f) Circular fibres of the iris.
- (g) Radiating fibres of the iris.
- (h) Pigment layer of the iris.
- 1. Radiating fibres of the ciliary process.
- 2. Circular fibres of the ciliary process.
- 3. Canal of Petit.
- 3. Ora serrata.

- 4.4. Anterior ciliary arteries.
- 5.5. Anterior ciliary veins.
- 6.6. Short posterior ciliary arteries.
- 7.7. Short posterior ciliary veins.
- 8. Lamina fusca.
- 9. Tunica vasculosa.
- 10. Membrane chorio-capillaris.
- 11. Lamina elastica, or limiting membrane.
- 12. Macula lutea.
- 13. Optic nerve.
- 14. Pigment layer of the ciliary process.
- (A) Aqueous chamber.
- (L) Lens.
- (V) Cavity of the vitreous.
- (S) Sclerotic coat.
- (R) Retina.
- (D) to (D) Danger zone.

Uveal tract in red.

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lapsed into the conjunctival sac or exposed for a time I should have excised the prolapsed portion and closed the wound.*

Carefully and cleanly-dressed wounds of the cornea seldom give trouble and heal with promptness. Light, frequently changed bandages, a sterile salt solution, or a boric acid solution instilled every one, two, or three hours, with the aid of the tears, will be sufficient for most cases.

The great danger comes from lack of cleanliness on the part of the attendant, from a septic conjunctiva, or a suppurating lachrymal sac or nasal cavity.

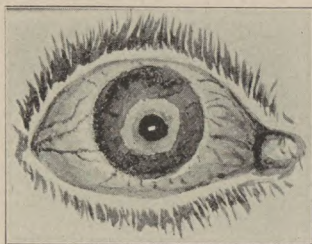


FIG. 92.

Central ulcer of cornea with hernia of membrane of Descemet.

This patient, fifty years of age, is a stone-cutter. Four or five days ago, while dressing a granite block, he was wounded by a fragment lodging on the nasal side of the right cornea. The foreign body has given him no trouble except when he first retires. Cocaine has been applied and upon inspection we find a small, gray eminence of jelly-like consistency about two mm. in diameter. (Fig. 92.) It is very tenacious and difficult to remove with a spud. The excavation seems to extend to the deeper portions of the cornea, the tissue for about two mm. in each direction being cloudy.

*The result of the management has been satisfactory, the corneal wound has healed, the iris is nearly regular in form, and the only evidence of internal injury is a small, white spot just below the center of the lens. The lens was evidently contused by the iron but the capsule did not rupture.

At the apex of the cavity I find a small fragment of stone pressing against the internal, or Bowman's, membrane. The fragment is removed, the cavity sterilized with a ninety-five per cent. solution of carbolic acid and the eye will be bathed frequently with boric acid solution.

Injuries of this kind heal very slowly and it is not uncommon to have the three outer coats destroyed and the endothelial layer pressed outward in the form of a minute hernia. Such complications necessitate the lowering of the tension of the eye by a small paracentesis of the cornea. The aqueous should be drawn out through the pericornea, thus allowing the hernia to recede and the ulcer to close up. Galvano-cautery may be required to stimulate the process of repair. When the ulcer is central atropia should be instilled; when peripheral, one-half per cent. solution of eserine should be used. It far safer to perforate with a knife and reduce tension than to leave it to chance. Introduce a paracentesis needle, or, if you do not have one, use a sharp, keen-pointed bistoury or Graefé knife. Enter the anterior chamber to the scleral side of the corneal junction, the knife directed in the plane of the iris; when the anterior chamber is entered rotate the knife just enough to allow the aqueous to escape very slowly and withdraw the knife before it is touched by the iris.

Various ointments have been employed but the following I think one of the best for corneal ulcerations which have passed the acute stage:

R.	Hydrarg. flav. oxid.	gr viii.
	Vaselin	3i.
M.		

This is to be applied once in six to twelve hours, just a small portion put into the lower cul-de-sac of the conjunctiva with the tip of a round probe and the lids massaged until it is thoroughly mixed with the secretions.

Superficial wounds or abrasions of the cornea may result from the scratch of a pet cat, the fingers of a child, or a septic infection, and be followed by serious ulceration. These ulcers are usually superficial with shelving undermined edges and an extensive surrounding cloud.

This young woman while playing with her child received a scratch on the cornea. But a slight irritation followed until the fourth day, when she comes to the clinic complaining of severe pain and intolerance of light. There is a general conjunctival redness, excessive lachrymation, and some swelling of the ocular conjunctiva. The ulcer, which occupies the center of the cornea, covers about one-fourth its area, is irregular in form and has in parts shelving edges. The central portion is translucent, but the edges are gray and elevated. Movement of the lids causes great pain. The home treatment has not tended to improve the condition, for a strong solution of sulphate of zinc has been applied, together with a solution of cocaine prescribed by some druggist. The evident septic and irritable condition demands that we clean the ulcer thoroughly. To do this I have had a general anæsthetic administered, for cocaine or holocain anæsthesia would not be sufficient to allow thorough treatment. The eye is held open with a speculum and under a solution of bichloride— $\frac{1}{3000}$ —the entire margin of the ulcer is curetted, atropia is instilled and the eye filled with sterilized vaseline. The eye is then bandaged with a firm dry compress. The dressing is to be changed every three hours, atropia instilled, and washed with soda biborate or boric acid solution.*

The superficial portions of the cornea are frequently involved in ulcerative processes in low continued fevers and paralysis of the orbicularis muscle where care is not taken to protect the cornea. As a preventive measure see that the eyes are bathed with a soda biborate solution containing a

*On the fourth day the bandage was discontinued. Atropia instilled once a day. Complete recovery.

little gum acacia, five drops of the solution in each eye every hour or two, and the eyes kept closed.

Mr. T. O. P., aged thirty-two; has just recovered from a relapsed typhoid fever. During the course of the disease both corneæ ulcerated before the physician, who on account of his distance from the patient saw him only once in five or six days, discovered the condition. Attention was at once given to the cornea, and perforation did not result. We have, however, an extensive cicatrix over the lower half of each cornea, and the pupil is so much obscured that it will be necessary to do iridectomies opposite the clear cornea to improve his vision. (Fig. 93.)

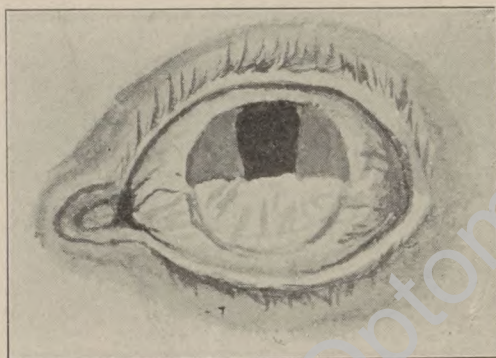


FIG. 93.

Iridectomy for artificial pupil in corneal scar in case of corneal necrosis in typhoid fever.

Corneal ulcers assume different forms, sometimes beginning at the margin of the cornea and extending its entire circumference, leaving an island of clear cornea in the center; at other times beginning at the margin of the cornea and pursuing a more or less regular line across it, with straight, regular edges, at others with beveled, slanting margins. (Plate XVIII, Figs. 1-5.) There must be local conditions which favor ulceration, such as loss of nervous tone or paralysis, peculiar or specific infection from an infected lachrymal sac or nasal cavity, or from the rupture of the epithelial layer and the introduction of pyogenic germs.

The case we have to-day, Miss L., aged nineteen, was struck upon the open eye with a fragment of stone. Her vision at once became low, the eye was injected, the cornea dull, but not broken. There was no pain or irritation. The field did not seem to be obscured by hæmorrhage, nor could I make out that the lens was displaced. To-day, the second following the injury, we find an extensive slough of the cornea. There is still no pain and the vision is not, now that the cornea has been cleaned, any lower than at the former examination. So far as I can see there is a simple exfoliation of the bruised outer coat of the cornea. Our treatment has been frequent irrigation with the sterile normal salt solution, a light cover bandage, and perfect rest. The conjunctiva and lachrymal passages appear to be free from disease and the tears are normal in reaction. We shall not interfere with Nature's repair unless she seems to need assistance.

Corneal ulcers may result from infection from a diseased lachrymal sac; usually, however, it is necessary that there be conjunctival irritation or abrasion to put the cornea in condition to receive and develop the infection.

May O. M., aged twenty-six, has been suffering from a dachryocystitis for years. The conjunctiva is constantly bathed in excessive catarrhal secretions and the pus from the sac constantly discharging into it. About a week ago she noticed a superficial white spot on the nasal side of the left cornea near the limbus. (Fig. 94.) The spot constantly increased in size extending up and down until about three-fourths of the corneal margin is sloughing and the disease has invaded the deeper layers. Upon removing the slough we find that the internal limiting membrane is protruding about two mm. The pain is severe. I shall clean the lachrymal sac and inject it with a twenty per cent. solution of protargol; pass a ligature about the canaliculus and open the sac through the integument; flush the conjunctiva with a $\frac{1}{3000}$

bichloride solution; and direct the nurse to clean the eye every two hours with a solution of hot boric acid. If the cornea is not improving and the projecting limiting membrane is not receding by the second day, I shall draw off the aqueous as in case represented by Fig. 93.

(Ten days later) The condition of the ulcer not improving and the conjunctiva less septic, I feel justified in making the paracentesis. This done I shall with no little misgiving trust for betterment, for there is danger of general infection. The eighth day the cornea is almost closed over with an extensive

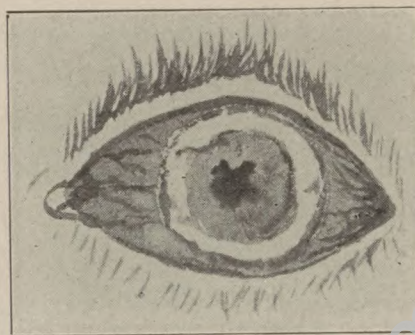


FIG. 94.
Corneal ulcer, serpiginous.

scar covering the site of the ulcer. I shall remove the sac. In this case I have found the salt solution most soothing.*

Mr. L., a street-car driver, forty years of age, comes to our clinic giving the following history: Just before retiring about sixty hours ago, he felt a sharp, stinging pain in the right eye. The pain continued during the night and he applied a poultice of hot flaxseed meal. The next day and night he suffered only little pain, but he comes this morning complaining of increased distress and almost total blindness. The epithelial layer of the cornea is unbroken, but there is a conical projection of the center of the cornea. The entire cornea is a dull yellow, the peri-cornea is deeply engorged, and the tension of the eye above normal. (Plate XVIII,

*I would to-day use protonuclein in such a case.

Fig. 2.) The cornea is not very sensitive to touch and it seems to be slightly fluctuating. He has been having a series of boils on the neck and shoulders.

Treatment:

I shall make a small incision through the external layer of the cornea and allow the contents of the abscess to discharge, then use bichloride— $\frac{1}{3000}$ —freely, and apply a dressing of boric acid solution every two hours for fifteen minutes at a time.

The prognosis is very unfavorable. The probabilities are that the deeper parts of the eye are involved and that panophthalmitis will result.

On the fourth day the iris, choroid, and cavity of the vitreous, are involved in the inflammation, and as the infection has not seemed to extend to the orbit I have advised an evisceration. First eviscerate the eye under a stream of $\frac{1}{1000}$ bichloride solution, then remove the stump of the choroid and pack the cavity with iodoform gauze.

An inspection of the discharge and removed structures gives abundant evidence of mixed infection bacilli. *Enucleation is not a safe procedure in panophthalmitis.*

Some years ago the practice of using the actual cautery in superficial ulceration of the cornea was common and seemed to give very favorable results. I have also seen it used in corneal abscess destroying the entire thickness of the cornea and allowing prolapse of the iris. I only mention it to condemn the practice of deep cautery. The use of superficial cautery, both thermal and galvanic, is of great value. About nine years ago I removed a pterygium from the eye of an eminent physician, and eighteen months later the growth had returned and extended over a much larger area than at first. The tissue was examined microscopically and pronounced to be an epithelioma. It was again removed and the area involved gone over with the cautery superficially. About fifteen months elapsed when it was discovered that about one-third of the cornea was involved; the growth ex-

tending this time to the superior ocular conjunctiva. Fragments of the growth were removed for examination, and the entire surface deeply involved cauterized. This was done about six years ago and there has been no return of the trouble, the cornea is clear and the vision perfectly good. I recently examined the cornea and could find no evidence of the corneal burn. It was transparent and has no irregularities. The burn in this case did not extend deeper than the epithelial layer. (Fig. 95.)

Indolent ulcers of the cornea may remain in about the same condition for days, causing but little photophobia and no pain. For this condition I have used protonuclein, special, with the best results. Calomel dusted into the eye in some

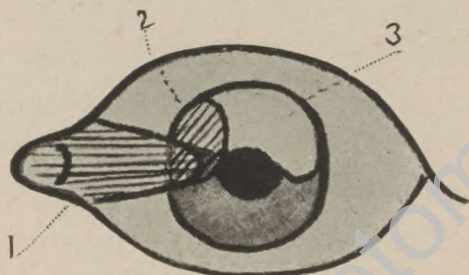


FIG. 95.

cases has proven beneficial. Carbolic acid should not be applied in such cases and the bichloride of mercury usually does more harm than good, for the unbroken cornea in this class of cases does not respond favorably to any form of mercurial ointment, frequently becomes gray and the superficial layers are exfoliated and not quickly repaired.

Mr. K. L., aged sixty-two years, a German of moderately good habits but rather feeble general health. The vision of his right eye was slightly impaired. He consulted his family physician, who prescribed a zinc sulphate solution which caused him some dull pain but no special smarting. This was used for about a week when he returned for further advice and the physician discovered a small corneal ulcer

Fig. 1.

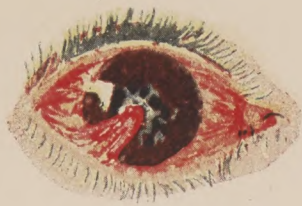


Fig. 5.



Fig. 2.

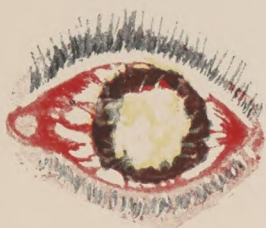


Fig. 6.



Fig. 3.

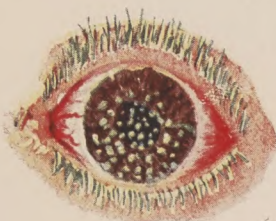


Fig. 7.



Fig. 4.

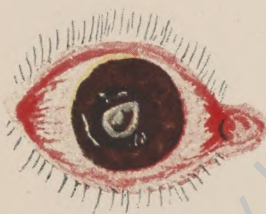


Fig. 8.



PLATE XVIII.

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about the center of the cornea and referred him here for treatment.

There is a small, regular ulcer about two mm. in diameter filled with a gray, plastic plug. It extends to the internal, limiting membrane for when the plastic matter is removed there is a dark bead projecting into the base of the ulcer. At the lower margin of the cornea in the anterior chamber (Fig. 96) there is an accumulation of leucocytes. They are in the anterior chamber for the whitish deposit, which is called a *hypopyon*, moves to one side or the other as the head is inclined. If the deposit was in the corneal substance its position could not change. From the ulcer to the hypopyon there is a trace of the gravitating deposit. There

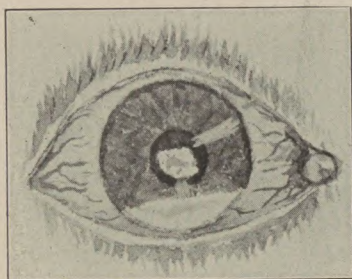


FIG. 96.
Hypopyon keratitis.

is a slight increase of tension and much deep pericorneal congestion. The conjunctiva and lids are not inflamed, the lachrymal secretions are rather scant, but the drainage seems to be good. I have advised a saline laxative to be taken twice daily and two grains each of calomel and of soda bicarbonate, taken at night for three nights, also strychnine sulphate $\frac{1}{80}$ gr. every four hours. Locally I have ordered a salt solution, ten grains to the ounce, used every hour; and once in four hours, after the salt solution, a small quantity of pro-

tonuclein, special, dusted into the eye from a cotton pledget wound on a toothpick.*

Mr. A., aged sixty-seven, has a chronic ulcer of the cornea centrally located. It has been under treatment for several weeks without improvement. There is no severe pain, no excessive lachrymation, just a dull, dead sensation. Calomel has been used for several days, the sloping edges of the ulcer have been curetted. Resorcin has been applied and in fact everything has been done with which I am familiar to induce a reparatory process. The discomfort, while not great, is sufficient to lower the general tone of the patient in spite of tonics and stimulants. The most serious feature of the case is the glaucoma-like hardness which has come on during the past week, though we have not used atropia, but since the tension has increased we have used eserine, one grain to the ounce of water. The ulcer has slowly but surely spread until now four-fifths of the surface is involved.

The second serious condition with which we have to deal is the irritability of the fellow-eye. The prognosis is so unfavorable that I have, in view of the patient's health, the certainty of blindness in the diseased eye, and the danger of sympathetic glaucoma in the second eye, advised enucleation of the ulcerating eye. The patient has expressed his wish that it be done to-day.

The macroscopic appearances are drawn from a photograph (Fig. 97) (a) corneal ulcer, (b) exudate in the posterior space of the aqueous, (c) exudate in the region of the ciliary body.

Upon microscopical examination of the exudate, pus cells, leucocytes and plastic matter were found.

The recovery was uneventful. He has been myopic from childhood and an examination of the second eye showed ex-

*On the second day after this treatment was instituted the hypopyon is almost clean and the base of the ulcer filling in. Ten days later the eye is perfectly healed, with a small scar.

tensive choroidal patches. There are also stigmata of hereditary syphilis. The corneal ulcer was but one of the chain of conditions and to have allowed the eye to remain longer would have been to invite acute disease in the fellow-eye. Enucleation was the only safe procedure.

Mr. C., a farmer from Indiana, aged thirty-four years, had malaria during the spring. He is referred to us on account

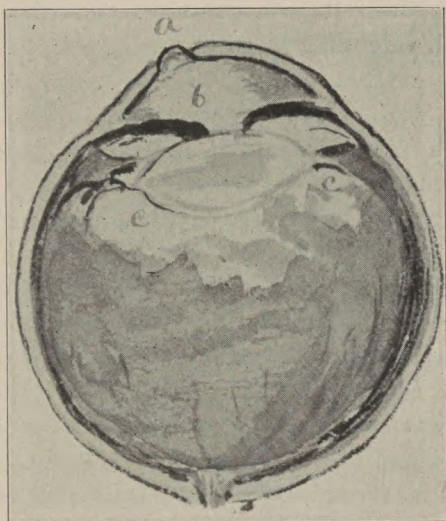


FIG. 97.
Corneal ulcer. Exudate and pus in anterior chamber and on ciliary body.

of lowered vision supposed to be due to an overdose of quinine. The eyes are very painful, vision low, the cornea generally gray and the conjunctiva inflamed. A close examination of the cornea reveals several lines of infiltration extending from a central stem like the veins upon a leaf. (Plate XVIII, Fig. 5.) This form of keratitis is rather common in malarial districts and is always chronic in its course. Local treatment has but little effect upon it. Atropine may be used to

allay the photophobia, and hot fomentations may be applied once in four to six hours, for half an hour at a time. The treatment producing the best results is directed towards the general condition. The corneal opacities may clear under the use of mercurial ointment, though my experience is not in accord with the reports of the advocates of the yellow ointment.

Vascular Keratitis in the adult is rather rare, though in tubercular children it is a common condition and usually occurs as a phlyctenular keratitis.

Mr. C. McK., aged twenty-eight, a farmer, has been in poor health for some months and from a recent examination is pronounced to be in the early stages of tuberculosis. Two months ago he noticed a small red spot on the cornea and a bundle of blood vessels extending to it from the conjunctiva. (Plate XVIII, Fig. 1.) About the cornea are several elevations. The Meibomian glands are suppurating but not acutely inflamed. The cornea is clear except the area involved, there is no pain and but little irritation. The corneal ulcer is undoubtedly tubercular and the local infection from the discharge of the tubercular Meibomian glands. The infected glands should be incised from the margin of the lids, and curetted and cauterized with ninety-five per cent. solution of carbolic acid. The cornea should be treated as though it was a phlyctenular keratitis; the head of the fasciculus of blood vessels excised as for pterygium; the cornea and pericornea thoroughly seared with the galvano- or thermo-cautery. The subsequent treatment will depend upon the thoroughness of the cautery and the reparatory power of the patient.

Superficial inflammation may follow exposure to strong wind or the pelting of sand upon the cornea in a sand storm.

Master K., aged fourteen, after rowing and fishing all day yesterday, this morning awoke with painful, inflamed eyes and lowered vision. A portion of the ocular conjunctiva is congested and the cornea gray and roughened. The irritation can be relieved promptly by flushing the eyes with a saturated solution of biborate of soda, or with camphor water every two hours, and two drops of adrenalin chloride once in two or four hours. The eyes should be protected by London smoke-glasses for a few days.

Mr. K., aged forty-two years, has been exposed to the dust and wind during a long ride through Kansas. Four days ago his eyes became painful and vision poor. There was ocular inflammation during the first day or two. The cornea is gray and dotted by small blisters, filled with an opaque fluid. (Plate XVIII. Fig. 4.) The eyes will be cleansed with a ten-grain solution of boric acid with ten drops of glycerin to the ounce of water. Atropine will then be instilled and a dry compress bandage applied. The bandage should be removed and the cornea inspected every four hours. If after twenty-four hours the elevations have not been absorbed they should be punctured and the dressing reapplied. I have seen cases, similar in appearance and origin, result in extensive necrosis of the cornea with tedious recovery and much loss of vision.

Interstitial keratitis, or inflammation of the corneal substance, is characterized by an infiltration of the deeper parts of the cornea. The superficial layer is not necessarily involved, though the surface is slightly lowered in lustre. The deeper obstructions are cloudy and in some parts opaque, while other portions are clear. (Plate XVIII, Fig. 8.) The iris in the early stage of the disease is irritable and later inflamed; it is also adherent to the lens, sometimes causing complete occlusion; there is pericorneal injection which does not disappear upon pressure. Much or little photophobia exists according to the extent of the disease. In the later

stages the iris, ciliary body, and choroid are involved; and blood vessels extend into the cornea giving the opacities a pinkish tone. There is no tendency to suppurate or ulcerate. In elderly people glaucomatous attacks may occur with total blindness. Hereditary syphilis is the usual cause of this form of corneal inflammation, though I have seen cases where there was no evidence of syphilis in the person or history of the patient's parents. Typical cases have the Hutchinson teeth (Fig. 98) and other evidences of hereditary syphilis.

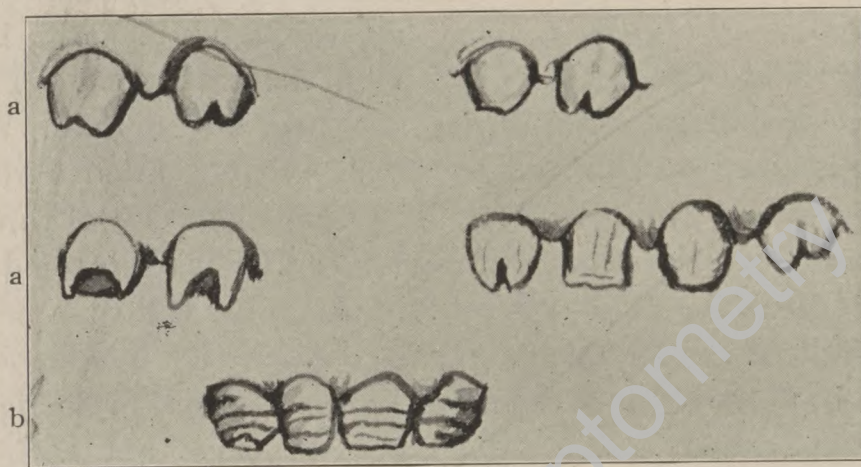


FIG. 98.

- a. Teeth in inherited syphilis.
b. Teeth in strumous and rickety patient.

This child, aged eight years, has suffered from early infancy with keratitis. She is anæmic; both mouth and throat are deformed and diseased; the teeth decayed and characteristically (Fig. 99 and 100) notched. The post-nasal space is filled with adenoids and the post-auricular gland enlarged. The cornea, from continued disease, is degenerated and opaque. She is referred to us to see if an iridectomy can be made to allow the passage of light, as the pupil is completely blocked. The cornea has no area clear enough to allow of useful vision. The iris is adherent to the lens and cannot be detached. The eye as a whole is diseased, and

from her inability to distinguish the light of the room from the light of the window, I should judge that the media back of the iris were not clear enough to transmit light or that the retina from disease, or disuse, has become insensible or atrophic.

Her brother, who also suffers from the same condition, and is four years younger, offers some hope from treatment. Both eyes are involved. The right cornea bulging, an anterior staphyloma (Plate XVIII, Figs. 6 and 7), the left cornea gray and lustreless, and on the nasal side deeply infiltrated. There is slight photophobia. The iris is not adherent. Vision 20/200 in each eye. The child is better nour-



FIG. 99.
Case of interstitial keratitis.

ished than his sister and his eyes have not been so constantly or seriously inflamed. We will prescribe atropia sulphate one-half per cent. solution, instilled twice daily, a soda biborate bath for the eyes and

R	Hydrarg. chlor. cor.	gr. i.
	Potass. iod.	ʒii.
	Aqua dest.	ʒvii.

M.

Sig.—A teaspoonful, in water, once in four hours.

The general condition of the child should be improved and a simple diet enforced. I have no confidence in the ordinary iron preparations in these cases, but believe that cooked fruits

and vegetables will furnish all that can be assimilated. Most children under this treatment, plus country life, will recover with little loss of vision, and after twelve to sixteen years of age will be beyond the danger of relapses.

The iris, ciliary body and choroid coat form the vascular tunics of the eye. They are intimately related both in blood and nerve supply, and while differing in function are almost identical in structure. Any diseased condition affecting the one modifies the nutrition of the other divisions. The iris is the curtain of the eye and its function is the same as that of the diaphragm in the photographic camera. Its movements are controlled by two sets of nerves, the long

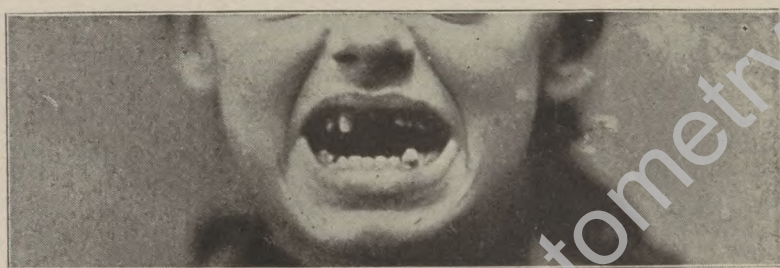


FIG. 100.

ciliary branch of the third, and the sympathetic. The third acts upon the sphincter or circular fibres causing them to contract, while the sympathetic acts upon the radiating fibres causing the pupil to dilate. Its blood supply is from the long ciliary artery and some branches of the conjunctival blood supply. Plate XVII. illustrates the muscular arrangement and blood supply.

The iris is subject to direct and indirect injuries. Any instrument or missile entering into the anterior part of the eye may wound the iris, or by draining away of the contents of the anterior chamber cause the iris to prolapse into the wound.

This patient, M. O. C., three days ago, while working at his lathe, was struck by a wire-like fragment of steel, wounding the cornea at its lower temporal third. The iris prolapsed and is now held by the lips of the corneal wound, There was not at the time of injury any wound of the iris, for there has been no blood in the anterior chamber. The lens was not injured, for if it had been it would by this time be losing its transparency and vision would be impaired. We have then only a simple wound of the cornea and a prolapse of the iris. The prolapsed portion must be excised and eserine used for a few hours to draw the iris away from the corneal wound. If there is pain or redness following the replacement of the iris atropine one-half per cent. solution should be used, two drops every four hours, until the irritation subsides.

A penetrating wound of the cornea, iris and lens.

Mrs. N., aged fifty-two, ran a knitting-needle in her right eye near the nasal side of the cornea. It passed obliquely across the eye and wounded the iris, lens and ciliary body. She consulted her physician who advised her to come to our clinic. This was three weeks ago and on the afternoon following the injury. She did not follow his advice (as he informed her that the eye would have to be removed) but consulted a faith-curst who gave her treatment until the pain and suffering became unbearable, and, most serious of all, the other eye became painful and its vision lowered so that she can only see large objects. *To-day she is practically blind.* The injured eye is in a state of non-suppurative inflammation. The iris is adherent to a swollen and displaced lens, the cornea distended and the wound filled by the prolapsed iris. The ciliary body is intensely inflamed and painful and the eye as hard as a marble. The fellow-eye is painful, the iris contracted and the cornea dotted on its under surface with minute stipplings. The iris which is bulging is of a dull reddish-green color and the ciliary region deeply pink.

The pupil is too narrow to allow of an examination of the deeper structures of the eye.

The prognosis is grave and the rational thing to do would be to remove the right eye at once, if the symptoms of ophthalmia were not so serious in the left eye, but this eye is liable to become totally and hopelessly blind in spite of treatment. I shall delay a day or two the radical procedure upon the right eye and do an iridectomy with extraction of the lens instead, and see if the symptoms in the left will not subside.

The operation is made in the following manner. A narrow Graefé knife is passed into the anterior chamber and passed out without regard to the iris or lens. The softened lens matter flows out freely as the incision is completed. The prolapsed portion of the iris is excised and the soft lens matter cleaned away. There is a small loss of vitreous fluid. The tension of the *left eye* being high—plus two—the aqueous is withdrawn through a small corneal wound and both eyes bandaged with dry compresses held in place by starched gauze.

History.—The third day, eyes not painful, wounds doing well. The fourth day, slight increase in tension in left eye. Tenth day, right eye quiet and corneal wounds perfectly healed; left eye quiet with improved vision. Thirtieth day, vision in right eye with correcting lens=20/200; in left eye=4/200.

The treatment of an injury of this kind demands promptness and decision: enucleation of the right eye promptly done would have given this patient one good eye; but the delay was disastrous and she now has only vision enough to move about and avoid objects in familiar surroundings. My reason for not enucleating the right eye at once is based upon experience. The left eye might have gone on to total destruction in spite of the enucleation; it is little better than that now. There was the chance that the relief of tension

from the iridectomy and removal of the lens might have the desired effect upon the left eye; and that there was a clear cornea and retinal life left which would give useful vision. The vision now remaining in the right eye is improving and will continue to do so; it may in time with correcting glasses allow the reading of large print.

Foreign bodies lodged in the iris are a great source of danger and they should be removed promptly and if possible before the wound in the cornea has closed.

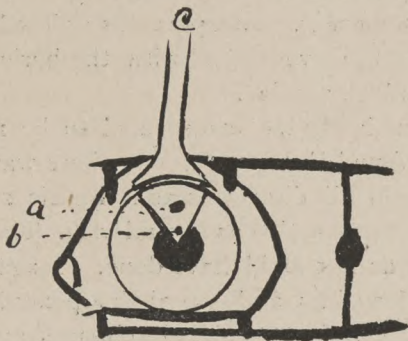


FIG. 101.

- a. Location of foreign body in iris.
- b. Wound of entrance.
- c. Keratome in position.

Mr. C. N., aged thirty-two, a machinist, received a fragment of brass in the left eye, just below the center of the cornea, which lodged in the iris about midway to the sclera. A magnet cannot be used. The wound is too central to warrant enlarging it, so I introduce a narrow keratome at the pericornea, and withdraw it quickly, with the gush of aqueous which follows the iris is slightly prolapsed and the fragment is within easy grasp of the forceps. Upon removing it there is a slight hæmorrhage. The eye is closed, the aqueous quickly fills the anterior chamber and the iris is drawn back into its place. Atropia is then instilled and a dry bandage applied.* (Fig. 101.)

*Recovery was made without incident or complication and vision only slightly impaired by the corneal scar.

Master L., aged sixteen years, was struck by a fragment of a percussion cap at the sclero-corneal junction of the right eye, temporal side. It passed inward and lodged partially in the iris and partially in the ciliary body. The wound of entrance was ragged and while there has been a free hæmorrhage externally, but little entered the anterior chamber. I could not at that time determine whether the lens had been injured or not. Cocaine was instilled and the foreign body removed with some difficulty. Upon its withdrawal a bead of vitreous followed. I advised an immediate enucleation, but the parents did not consent. Atropine was ordered instilled three times a day and the eye flushed with the boric acid solution and a light bandage applied.

On the fourth day the eye seemed to be normal in tension and the wound doing well, but there was a deep pink flush extending in all directions and the iris seemed slightly discolored and not as active as I could wish. The pupil did not dilate as freely as it should have done. I again pointed out the dangers of cyclitis and a probable panophthalmitis, but the parents were willing to take the chances and again there was delay.

This is the twentieth day since the injury. The iris is contracted, the cornea surrounded by a deep pink zone, the tension plus two, and there is but little pain and tenderness.

I cannot see the fundus, and the vitreous and posterior capsule are clouded. The fellow-eye is irritable and avoids the light, and the act of accommodation is painful; it is in a state of sympathetic irritation. There is no evidence of inflammation. I consider that the danger of sympathetic ophthalmia is imminent and that it is our duty to insist upon the immediate enucleation of the injured eye; or that, as the parents do not consent to the operation, we are, in justice to ourselves, obliged to terminate our connection with the case. I always refuse to continue in charge of a case of this kind when my judgment is not accepted and acted upon.*

*From the physician who referred the patient to our clinic I have the following in answer to my inquiry regarding the case: "The right eye be-

Wounds involving the ciliary body and iris are most frequently followed by chronic inflammation of the injured eye and sympathetic disease in the fellow-eye.

When we consider the character of the structures involved, the functions, nerve supply, great activity, and the almost constant demand made upon the ciliary body, we can fully appreciate the dangers from injury, direct or indirect. The causes of sympathetic disease in the fellow-eye are not so clearly made out, but experience teaches us that they exist. I shall refer you to the various text-books on ophthalmology for the different theories regarding sympathetic ophthalmia, and only point out the objective and subjective symptoms.

The danger zone extends about fifteen mm. from the sclero-corneal junction. It includes the region of the iris, ciliary body, and, secondarily, the lens, retina, and choroid. Wounds, concussions, injuries, or long-continued irritation in this region may cause sympathetic irritation or disease in the other eye. A wound may heal with promptness and leave but little trace of the damage done, yet the fellow-eye may suffer a serious and acute inflammation which will destroy vision in a few hours; or the primary wound may be slow in healing, or go through a violent suppurative or non-suppurative inflammation which may terminate in atrophy of the globe with degeneration of the uveal tract, without the fellow-eye becoming in any way involved. The primary eye may remain quiet for a time and then become sensitive, painful, and tender; while the second eye is disturbed by periods of asthenopia, until slowly or quickly the vision is destroyed by non-suppurative panophthalmitis.

Primary injuries to the ciliary region are wounds, contusions and inflammations. The secondary injuries, continued disease in adjacent parts, or the pressure of a wounded and swollen lens upon any part of the uveal tract.

came distended and the wound opened; it was then enucleated. The left eye became nearly blind during the fourth week following the enucleation. He can see large objects, avoid chairs; can walk on the street in daylight, but after dark he cannot see to go about."

The symptoms of sympathetic irritation and inflammation are, 1st. Painful vision, with or without flushing of the conjunctiva. 2d. Impaired power of sustained accommodation. 3d. Complete suspension of the act of accommodation. (The three preceding symptoms frequently occur in the early stages of sympathetic inflammation, but this prodromal period may be obscured or entirely wanting and the inflammation ushered in at once by a sudden lowering of vision.) 4th. The posterior surface of the cornea is stippled with gray dots (Plate XVII, Fig. 3) which are thrown into the aqueous from the ciliary body and iris. 5th. The pupil is contracted and does not respond to light or atropine. 6th. The tension of the eye becomes high. 7th. The ciliary region is congested and gradually the entire visible portion of the globe and iris becomes deeply engorged. 8th. The eye is excessively tender and painful. 9th. The pupil is blocked with exudate and the iris adherent to the lens. 10th. The vision has gradually become lower and lower until all sensation of light is gone, or the loss of vision may be sudden and almost precede the symptoms enumerated above.

The most dangerous wounds are those involving the ciliary body and iris, with a prolapse of the iris which has not been excised or replaced. The time elapsing between the injury and sympathetic disease ranges from a few hours to several years. The longest interval in my experience was twenty-seven years and the shortest sixty-four hours.

The case which we have for study to-day, Mr. B., aged thirty-one years, came to our clinic about four years ago with a recent wound in the danger zone. The cornea was cut through the temporal third, the iris prolapsed, and the ciliary body wounded. The lens was hidden by a clot of blood. The wound was made by a splinter while he was cutting kindling-wood, and as the piece had been about the wood-shed for some months I feared sepsis and advised that enucleation be done at once. The patient refused to submit and

was discharged from the clinic. He returns to-day with the following brief history: The wound was allowed to heal without further attention from physicians, as those he consulted gave the same grave prognosis and advice that he received at our clinic. It was four months before he was able to use his eyes, and much of the time he has suffered severe pain. The second eye has been irritable most of the time. Two weeks ago the first eye became painful and within forty-eight hours the second eye was involved in a severe inflammation. Vision was lost within the first eight hours. The eye is now giving him severe pain. It is $+3$ in tension; the anterior chamber is obliterated and the pupil occluded and excluded. The primary eye is partially blind, there is complete posterior synechia, the iris is incarcerated in the wound, and I judge that the lens is destroyed by absorption. The anterior chamber is quite deep on the nasal side. I have advised an enucleation of the sympathetic eye and later an iridectomy upon the primary eye, hoping to recover a little vision, or at least retain the globe and its perception to light.

The lesson from this case is plain; a prompt enucleation would have saved the fellow-eye.*

Iritis may follow exposure to cold, strong light, irritation of the cornea or a direct or indirect wound or injury.

In syphilis, rheumatism, gout and septic disease, iritis is a common complication; it may be plastic, serous, or sero-plastic; the ciliary body is usually involved.

The subjective symptoms of iritis are pain, blurred vision, photophobia and a sensation of pressure within the eye. The pain is often referred to the temple or forehead.

*Six weeks after the removal of the sympathetic eye the primary eye was operated upon and a free excision of the iris made. The new pupil was blocked with membrane, but the light impression was stronger. I then removed the capsule of the lens, for such it proved to be, and after a slow healing of the wound the patient was able to count fingers at three feet and plus sixteen lens improved his vision to fingers at six feet.

Objective symptoms are pericorneal congestion and contraction of the pupil, which does not respond quickly to the use of atropia, and when it does respond is irregular in form. (Fig. 102.) The iris is changed in color; the blue or gray eye becomes a dull-green, the brown eye a duller brown. With the condensing lens in oblique illumination, the meshes and striæ are seen to be blurred; change of form and color being due to exudate and dilatation of the blood vessels. The pupillary margin is swollen and irregular, even before adhesions have taken place between the iris and lens. (Plate XIX, Figs. 1, 5, 6.) The pericornea is congested and tender and a gray



FIG. 102.

Some appearances of the iris when atropine has been used to attempt to dilate the pupil 1 and 2. Posterior synechia. 3. Occlusion. 4. Exclusion.

or yellowish plastic exudate may appear at the margin of the pupil which, if mydriasis is not complete, may become sufficient to occlude it completely. In serous iritis the exudate is not dense enough to block the pupil, but floats out into the aqueous rendering it turbid, and when it clings to the posterior surface of the cornea gives it a stippled appearance. (Plate XVIII, Fig. 3.)

The histories of attacks of iritis are various, ranging from severe acute onsets to the slow and insidious cases, which require the most careful observation to detect the condition

Fig. 1.

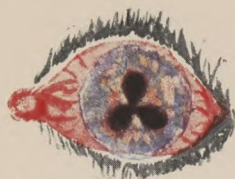


Fig. 5.

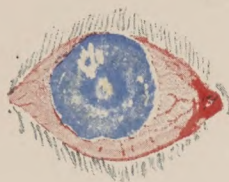


Fig. 2.



Fig. 6.



Fig. 3.



Fig. 7.



Fig. 4.



Fig. 8.

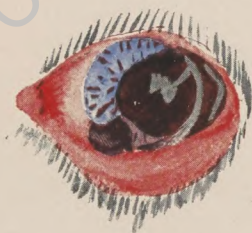


PLATE XIX.

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before it is too late to save the pupillary aperture or prevent posterior adhesions.

Mr. N., aged twenty-two years, about eighteen months ago had the initial lesion of syphilis. He had all of the primary and secondary symptoms, but did not take treatment until six months ago when he had a severe attack of pain in his legs and arms; at that time he had the skin eruption and bald spots on his head and face. He continued treatment for about six weeks when he was so far improved that he, on his own judgment, discontinued further attention. Four days ago he had severe pain in his right eye and about forty-eight hours later the left eye became inflamed. He applied moist heat and later an egg poultice. The pain has continued and he comes to us for treatment. The eyes are red, lachrymating and intolerant of light. The pain is most severe after midnight. The conjunctiva is inflamed; the cornea is gray and roughened from the use of the poultice; the pupils are contracted and the iris lustreless and greenish-blue in color. Atropia causes but little irregular dilation of the pupil. (Plate XIX, Fig. 1.) The tension is +1.

Treatment:

R. Calomel.
Sod. bicarb. aa. grs. ii.
M. Sig.—To be taken at night.

To be followed with sulphate of magnesia in the morning, and hydrarg. bichlor., grs. $\frac{1}{10}$, potass. iodide, grs. 20, taken in water every four hours. *Local treatment.* Atropia sulph., grs. 4, aqua, one ounce. Two drops in each eye every hour, for four hours, taking care that the tear ducts are held closed to prevent the atropine from passing into the nose and throat. Apply dry heat to the temples every two hours. At night hot water bags covered with cotton, hot water bottles, or hot bricks can be used on retiring. This will frequently prevent

the exacerbation of night pain. I do not advise the use of coal-tar derivatives for the relief of pain. Should the symptoms demand greater activity in elimination, inunctions of the nitrate or oleate of mercury should be employed in the axilla, groin, and popliteal space, fifteen or twenty grains being used every night. The patient should be kept quiet in bed, if need be, and in a darkened room until the acute symptoms are passed. The mouth should be cleaned carefully every four or five hours with a saturated solution of potassium chlorate; applied with a soft brush.

In those cases where the stomach refuses the potassium iodide the mercurial should be used alone and the potash salt added later in small, increasing doses. It may take some time to subdue the inflammation in this case, as there are



FIG. 103.
Posterior synechia.

extensive adhesions to break up and plastic deposits to be absorbed. Atropine one per cent. should be continued for two or four weeks after the inflammation has subsided.

The adhesions resulting from iritis are among the most frequent causes of relapse. Complete blocking of the pupillary space, occlusion, does not prevent direct communication between the anterior and posterior aqueous spaces; but exclusion so blocks the pupil that this interchange of fluid is prevented, and as the eye currents from the fundus forward are checked, the tension of the posterior chamber becomes too great and the iris is distended forward at its periphery and bound down to the lens in the center. (Fig. 103) In such cases the general tension of the eye becomes abnormally high, causing a form of glaucoma.

Mrs. L., aged forty-six, had specific iritis seven years ago. She has had several relapses during the past four years, some of them severe. She now comes complaining of severe pain in both eyes and complete blindness in the left eye. There is but little redness, though the danger zone is slightly flushed.

Vision in right eye $= \frac{20}{200}$. Vision in left eye = perception of light. The pupil in this eye is both excluded and occluded and as a result she has had for ten weeks severe pain in the eye and the vision in the right eye has lowered. Fig. 103 illustrates the relation of the iris to the lens. The pupil of the right eye is bound down by many adhesions and the cornea is dotted with exudate. The eye is in a condition of sympathetic inflammation. The patient is under a general anæsthetic, as cocaine has no effect upon the chronically inflamed eye. We shall remove a section of the iris and if possible improve the drainage. It is impossible in many cases to keep an artificial pupil open, it quickly fills with exudate and becomes completely blocked, necessitating enucleation to relieve suffering and lessen the danger to the fellow-eye. We have succeeded in removing a large portion of the iris. The section of the cornea is made with a Graefé knife. The knife is passed through the cornea and iris, keeping away from the lens. The corneal cut is carried well toward the sclero-corneal junction and the aqueous allowed to escape slowly, to avoid too sudden relief of tension, and prevent, if possible, a rupture of the diseased and weakened blood vessels. The iris will protrude and should be cut away. The eye is then covered for a few minutes, and as soon as the bleeding has stopped and all the iris within reach excised, atropine is instilled and a compress bandage applied. (Figs. 104 to 106.) The fellow-eye should be closely watched and if the tension becomes too great a paracentesis of the cornea should be made and atropia continued. Hot compresses or dry heat may be applied to the temples. It may be best to use opiates to relieve pain. All operative work should be strictly

aseptic, and the conjunctiva frequently flushed with hot boric acid or bichloride solution.

Gummata of the iris (Plate XIX, Fig. 2).

Mr. K., aged twenty-eight, was in this clinic for treatment of specific iritis about six months ago. He was faithful to his medicines as long as the pain lasted and the vision

OPERATIONS IN GLAUCOMA.

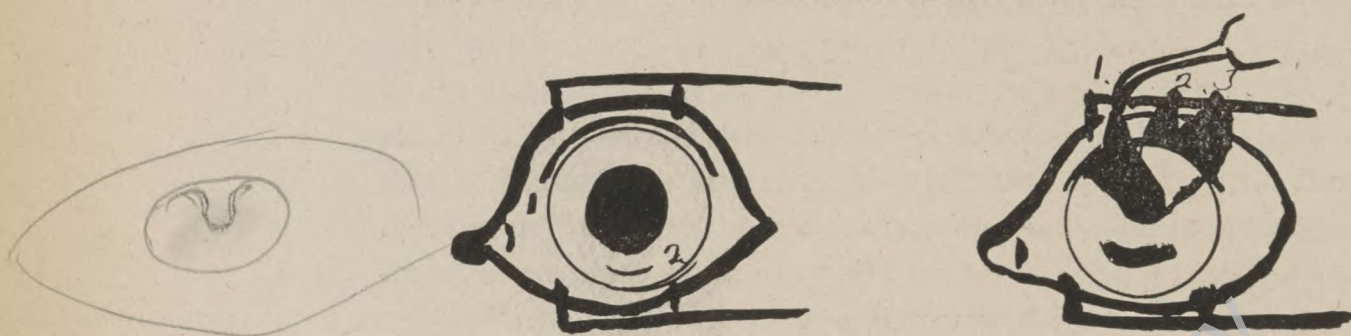


FIG. 104.

1. Corneal section in iridectomy for glaucoma.
2. Preliminary paracentesis.

FIG. 105.

- Section of iris in iridectomy.
1. 2, 3. Cuts with scissors.

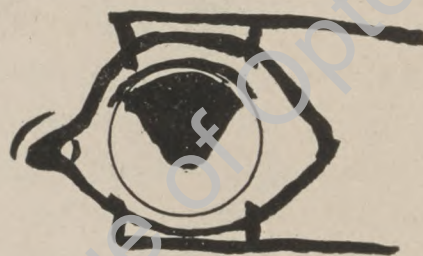


FIG. 106.

- c. Coloboma of iris after iridectomy.

was impaired. When we saw him last there was a strong, well-stretched synechia which refused to be detached from the lens and the anterior surface of the lens was studded with deposits of exudate. He now returns with the left eye slightly inflamed and painful and its vision obscured. Towards the temporal side of the pupil the iris is discolored and there is a small tumor about three mm. in diameter projecting slightly into the pupillary space. This is a gummata of the

iris and the iris is adherent to the lens. Tumors of this kind may form in any part of the uveal tract, optic nerve or brain. The treatment is that for the tertiary stage of syphilis and it must be thoroughly and promptly carried out.

Iritis resulting from rheumatism, intestinal toxæmia, gout, etc., is liable to come on insidiously with little or no pain and with but slight if any injection of the pericorneal layer, and but little if any change in the iris. The adhesions, however, are just as perfect and the synechia as persistent as in the more acute forms of the disease.

Mr. O. E. aged forty-one, has been drinking freely for some time and his elimination is low. Urine, sp. gr. 1008, with very low urea, and abundant flocculent phosphates. For two weeks past he has had little pains with very low accommodation power and a constant sense of weight in the eyes. He comes for correction of this error of refraction. The pericornea in the lower nasal region is slightly discolored. The iris before atropia was used seemed nearly round, but after atropia the pupils are found to be bound down in corresponding areas. Atropia must be continued, eliminants given, and stimulants discontinued.

Iritis, cyclitis and choroiditis without posterior synechia of the iris.

Mr. G., aged twenty-eight years, a book-keeper, has suffered from refraction asthenopia for many years and has been repeatedly warned that he must seek other form of employment. His family history is not good, his mother and one sister are highly myopic, and the father died of tuberculosis at twenty-six years of age. The patient is in good general health, but rather slender and apparently anæmic. His errors of refraction have been properly corrected and he is taking a good amount of out-of-door and gymnastic exercise. Three days ago he found it impossible to continue his work

on account of accommodative incapacity. To-day the pericornea is deeply flushed, the conjunctival vessels are distended, the pupil is slightly dilated and does not respond to light, but the iris is normal in color and the media clear. (Plate XIX, Fig. 6.) The eye is very tender to the touch and there is some pain, or rather an ache, upon every effort to accommodate. The tension of the eye is below normal; ophthalmoscopic examination reveals aqueous clear, lens normal and vitreous slightly cloudy in the region of the ora serrata, and extending into the choroid, the central vitreous is normal. The retina is also normal except for a physiologically cupped disk (?). Refraction corrected by a $+0.25$ with a $+1.50$, axis 90 in each eye.

This seems to be a case of cyclitis extending to the choroid, and to be the result of some systemic tendency aggravated by the use of the eyes. The local treatment is to be hot compresses applied for from fifteen to twenty minutes every two hours, atropine, one-half per cent. solution every four hours and potassium iodide, fifteen grains four times a day; with cod-liver oil, milk, cooked fruits, vegetables and cereals. (Dark glasses should be worn. I shall order his correction ground in number three London smoke.) He must change his occupation.

Jewelers, engravers, and etchers are subject to cyclitis with choroidal complications.

Mr. G., aged twenty-eight years, an engraver by trade, has had four attacks of cyclo-choroiditis during the past nine years. I have treated him during the last two attacks. I cannot find evidence of specific disease. The attacks have always occurred in the left eye though he uses his loup over the right eye. The condition of inflammation comes on slowly; he has first a sensation of discomfort followed by a dull ache; the pericorneal flush then appears slowly and becomes dense and the conjunctival vessels are not distended

until later. The tension in this eye was first below and later above normal. The condition is frequently mistaken for conjunctivitis. The diagnosis is easily made by pressing the lower lid firmly against the conjunctiva and noting the condition of the blood vessels; in simple conjunctivitis the tissues will become pale and the congested condition return more or less slowly, while in cyclitis the congestion is not removed by pressure.

The treatment of this class of cases should be promptly established. A complete rest of accommodation under atropine, one per cent. solution, dark glasses, and if an exudate has occurred potassium iodide in fifteen or twenty grain doses four times a day.

I have seen several cases occurring in workers with the jeweler's glass and in all of them the tendency to relapse was marked. In order to relieve this form I have advised that the eye not covered by the loup be covered with a shade, or that they use the binocular glass. The cause of the trouble seems to be an unconscious effort to accommodate to the short range. This persisted in for a long time impairs the nutrition of the ciliary body and choroid.

Plastic cyclitis.—I present this case for your consideration because we have an especially interesting pathological specimen, and on account of the exceedingly interesting history of the course of the disease, and the complications arising.

The patient, Albert Cohn, eight years of age, presented himself at this clinic three years ago, suffering from what was claimed to be sudden loss of vision in the right eye. The diagnosis of soft cataract had been made, and he was referred for examination. An investigation revealed the following conditions:

Vision equalled imperfect counting of fingers against a strong light at a distance of two feet; no change in appearance of conjunctiva; iris normal in color but slightly dilated. Upon looking into the pupillary space we found a whitish

curtain obscuring the fundus. This was not dense at the posterior pole of the lens, but toward the peripheral part of the field it gave a pearly-white reflex, explaining the diagnosis made before the case was referred to us. The tension was normal. Our diagnosis was plastic cyclitis. We could get no history of traumatism, or of any recent disease that could have any bearing upon the development of this condition; nor was there anything elicited from the family history that could account for this morbid growth. We kept him under observation for a short time before administering any remedies, hoping that we might gain some clue to the cause of the trouble. The parents were willing to bring him here, so that we had him under constant observation.

Finding that we were not gaining information by delaying treatment, we began the use of iodides and inunctions of mercury. The iris responded quickly to atropine. This treatment was continued over several weeks without modifying, in any way we were able to observe, the condition of the exudate.

About eight weeks following his admittance to the clinic we found that the fellow-eye was presenting some symptoms of general irritation; that there was a marked pinkish hue surrounding the cornea; slight intolerance of light and excessive lachrymation. Atropine was instilled and dark glasses prescribed. All treatment excepting the use of atropine was suspended. We noted the first *increase of tension* at this time; shortly afterward the cornea had become hazy, and tension rose rapidly. We advised the parents that immediate enucleation was imperative, *as the left eye began to show marked symptoms of sympathetic disease, i. e.,* floating matter in the anterior chamber; change of color; contraction of the iris and excessive lachrymation, and more or less nocturnal pain.

After a short delay the parents consented to an operation. Enucleation of the right eye was made before the class. Immediately following the operation the fellow-eye began to improve. In a week or ten days all symptoms had dis-

appeared, and vision, which had fallen to $\frac{20}{80}$, became normal. Since that time he has had no recurrence of the disturbance in the left eye. The stump of the right eye healed without delay.

I present to you for examination a section of the right eye. (Fig. 107.) The macroscopic appearance, as you will see by examining the specimen presented, is as follows:

The fibrous exudate in the anterior part of the chamber of the vitreous has displaced forward all the contents of the

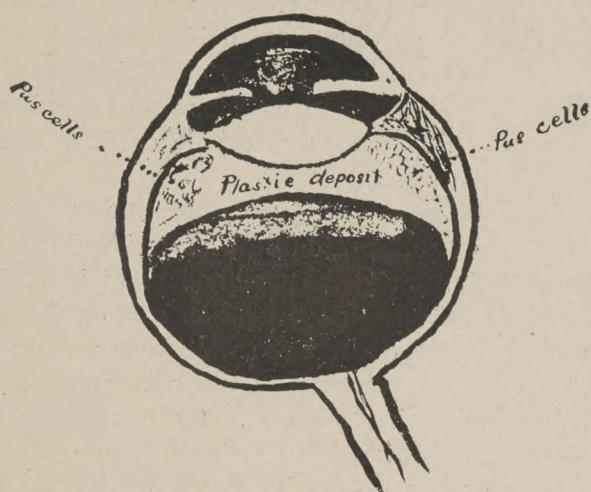


FIG. 107.

eye in front of the mass, obliterating the posterior chamber of the aqueous and rendering the anterior chamber exceedingly shallow, as in case of absolute glaucoma. The plastic matter showed no evidence of softening, though there were detached flakes in the posterior part of the vitreous. Microscopic examination showed an abundance of round corpuscles in the matrix of more or less organized fibrin. The ciliary processes were almost entirely obliterated, and the lens showed evidence of the interference with its nutrition.

One of the most interesting and unsettled points of this case is its possible cause:

First, we find that such cases may follow concussion or contusions in which the force has been sufficient to cause local irritation. Second, penetrating wounds not infrequently occur, even to the extent of laceration varying from one-eighth to one-sixth of an inch. The patient assures us that there has been no such accident, and that the eyes have not been exposed to any form of traumatism.

Cases have also been recorded where foreign bodies have entered the eye, the patient not noticing the entry, the hurt being so slight and temporary that it was forgotten. Children, especially the very young, are liable to sustain such injury, the nurse or parent forgetting or not being aware of its occurrence. So that the positive evidences of the causes of such conditions as plastic and sero-plastic cyclitis, cannot be obtained.

The diagnosis is sometimes very difficult when the plastic exudate is located well forward in the posterior chamber. It is only by carefully dilating the pupil and searching diligently with the ophthalmoscope that exudation can be discovered. It often appears in this location as a whitish or nebulous mass, sometimes completely surrounding the ciliary space, or circumscribed or limited in its extent. Or it may appear, as before described, together with a train of festoon-like strings obscuring more or less of the field; or occurring, as in this case, as a continuous mass covering the lens and ciliary body.

You remember in this case a diagnosis of soft cataract had been made before the patient was referred to us, and upon a superficial examination one would have confirmed this opinion. On close examination, however, with oblique illumination, also with the aid of the ophthalmoscope, we discovered that there was a clear space corresponding to the depth of the lens, and that the white mass corresponded to the general shape of its posterior surface, excluding, thereby, the possibility of its being a cataract.

In traumatic cases the prognosis is always unfavorable; in

idiopathic cases rather more favorable; in specific very favorable. A large per cent. of traumatic cases soon show signs of irritation, thereby warning us of the danger in store; or the patient may suffer from acute sympathetic inflammation precipitating at once the most serious sequel that could occur in cyclitic disease.

In this case the most alarming symptom occurred some days after we had advised enucleation, and that was increased tension of the *left eye*, and turbidity of the media. It was this circumstance that led us to declare that we would have nothing whatever to do with the case if the parents still persisted in delaying the operation. And we may consider ourselves fortunate that the sympathetic symptoms subsided so promptly, for such is not the rule, and in some cases of sympathetic irritation cyclitis, soon follows the stage of irritation and in spite of all treatment the eye is lost by general uveitis.

In a small proportion of cases of plastic cyclitis, yielding either to remedies or to improved general condition, the mass is slowly shrunken until it forms a fibrous membrane thinly covering its former field.

In specific cyclitis, the iris is usually first involved, the disease extending backward causing a general uveitis.

Operative interference is necessary when the eye becomes extremely painful, and suffering begins to exhaust the patient.

Enucleation was made in this case, giving, as you will see, a roomy cavity and a stump that is freely movable. The artificial eye now in place very nicely hides the defect.

A word of advice regarding the artificial shells may not be out of place: First, see that the shell you choose for fitting to the patient is carefully disinfected, first, with twenty per cent. carbolic acid, then carefully wash with sterilized water. This I advise because within the past few months a case of serious ophthalmia occurred to a former patient of mine, the inoculation being undoubtedly sustained from the

use of an artificial eye that had been recently placed in the cavity of some one who had just recovered from gonorrhœal ophthalmia.

To summarize: Plastic cyclitis is extremely rare, its cause in many cases is obscure. When the tension increases rapidly and the irritation begins to produce excessive lachrymation in the fellow-eye, it is advisable to enucleate at once. Sympathetic disease once established may not subside with the removal of the primary eye, but continue till the second eye is destroyed.

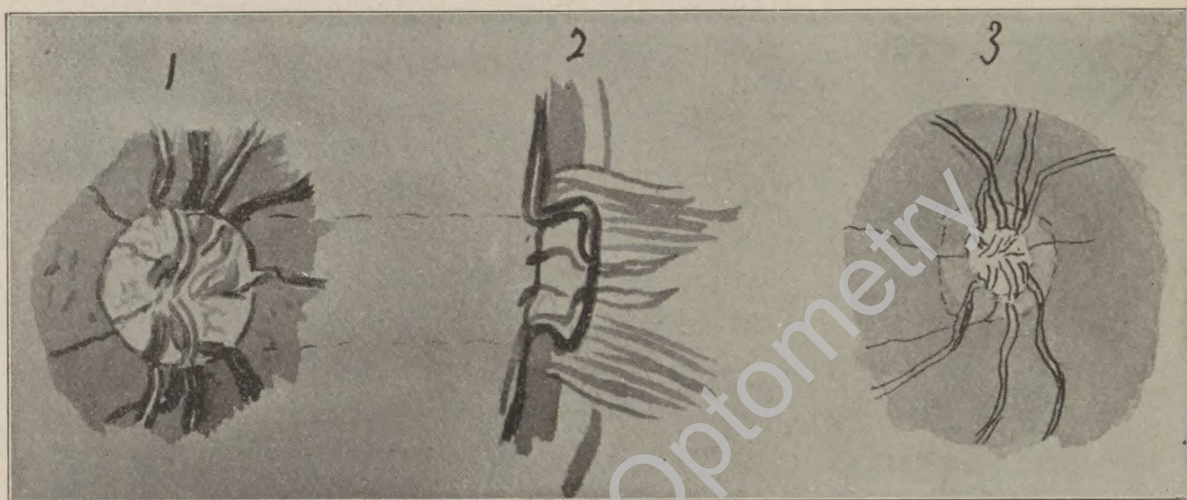


FIG. 108.

1. Cupped disk in glaucoma.
2. Schematic section of same.
3. Physiological cupped disk.

We have now before us a case of *glaucoma simplex*.

Mr. C., aged seventy-seven years, has been confined to his home for several months with rheumatic gout. Yesterday, June 17th, he ventured to visit the down-town districts. He wandered about the shops and looked into the show windows for several hours, becoming much fatigued. During the night he had severe pain in the left eye and side of the head with nausea and vomiting. In the morning the pain was less but he found that he was nearly blind in the painful eye. He

comes to our clinic for relief. The tension of the left eye is plus one. *The cornea is lustreless and not sensitive to touch. The pupil is dilated, the lens a greenish-gray and the anterior chamber is very shallow.* The ophthalmoscope is of little use although we are able to make out the disk in an imperfect way and *find some cupping, or pushing back, of the cribriform membrane, and that the blood vessels are below the line of the retina.* (Fig. 108). We have to deal with a case of acute glaucoma or over-tension of the eye due to fatigue of the iris and ciliary muscle, and to an increased secretion and imperfect drainage of the fluids through the spaces of Fontana into the lymph channel, known as the canal of Schlemm. (Plate XVII.) I have advised and shall do a broad iridectomy, using eserine in the fellow-eye until all danger is passed. It is important that you make an early diagnosis in this class of cases,* for they are frequently mistaken for attacks of nervous headache or supra-orbital neuralgia and the true condition is not realized until the vision is hopelessly lost. The *early treatment* is the most important. When called to manage such a case, at once instill a one per cent. solution of eserine and administer a dose of morphine hypodermatically; and if you have the instruments at hand, or can secure prompt assistance, an iridectomy should be made at once; in lieu of this, a corneal paracentesis should be done at once and the iridectomy later.

Mr. O. K., aged fifty-six years, is brought to our clinic for his blind and painful eyes. History: About two years ago he had severe pain in both eyes lasting some days. The family physician was called upon and prescribed for him. The pain subsided, but his vision, which had become low, did not improve. He then consulted a curist of some kind and was under prayerful treatment for a time when another attack occurred, not as severe as the first but of longer duration. His vision was now only sufficient to allow him to go about the

* The principal symptoms of glaucoma are italicized.

room. He lately consulted Prof. Smith for some joint trouble and he was referred to this clinic for his eyes. Vision is central (Fig. 109) and allows him to count fingers against a strong light. He complains of a large circle or halo of light surrounding the gas jets. For days he has only a sensation of light which continues in the dark, some times for hours after retiring. The tension of the eye is plus four, the anterior chamber is completely obliterated, the iris resting against the posterior surface of the cornea. The lens is opaque and seem-



FIG. 109.

ingly cataractous; the pericornea is congested but not tender, and the cornea allows of handling without giving pain. The long ciliary vessels are tortuous and distended. The condition is one of absolute or chronic glaucoma. Nothing can be done to improve vision, and there is some danger that operative interference might result in acute inflammatory symptoms. I shall, however, risk a paracentesis of the left cornea and shall instill eserine, hoping in that way to lower the tension of the eye and secure a greater depth of the anterior chamber and later do a sclerotomy (Fig. 110) and a small iridectomy.

About forty hours ago, Mrs. W., aged fifty-three years, was seized with severe pain in the left eye. There were circles of colored light about the lamp with vision low. Her physician, who was called about six hours later, recognized the nature of the trouble and at once instilled eserine. He advised her to consult an oculist, and when she presented herself at my office the tension in the left eye was plus two and the pupil was somewhat contracted by the eserine. Vision: preception of strong light when flashed across the eye.

The anterior chamber was very shallow and the lens and other media were translucent, the conjunctiva flushed and slightly œdematous. The fellow-eye was normal in vision and

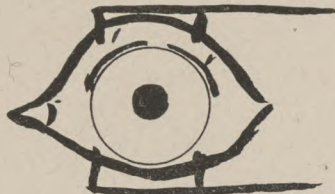


FIG. 110.

1. I. Pericorneal section. Sclerotomy.

2. The knife is withdrawn before the conjunctiva is completely severed.

appearance. We concluded that an iridectomy should be done at once. A general anæsthetic has been administered, as cocaine anæsthesia is not sufficient in glaucoma. (Cocaine does not produce anæsthesia in cases with + tension of the eye or chronically inflamed conjunctivas.) The anterior chamber is so shallow that I shall use a keratome to make the corneal incision, as follows: Enter the sclero-cornea well in the sclera, keeping the point of the knife away from the iris and lens, and allow the aqueous to escape very slowly to prevent the shock of too sudden lowering of the tension. The knife at the last moment should be withdrawn quickly and the iris allowed to prolapse. This is done to avoid entering the eye with the forceps, for the lens is displaced so far forward that even with extreme care it might be wounded by the forceps in case the patient made an unexpected movement. The

iris once in the grasp of the forceps is drawn well out and about one-third of its base excised with the first cut of the scissors; then the iris is drawn a little to the outside and another third excised, and again drawn to the side and completely severed. (Fig. 110.) This complicated incision is necessary in order to secure the largest iridectomy possible through the smallest opening or corneal wound. As soon as the bleeding has ceased, the iris carefully dressed into position, and the toilet of the wound completed, eserine is instilled and a dry compress applied to both eyes. It is now three months since the operation on the left eye. Vision is $\frac{20}{180}$ and is improving, and the tension is normal. Our patient is now complaining of flashing pains in the right eye and clouded and lowered vision, with the tension above normal. The iris is slightly contracted and the field of vision is narrowed and lower than three months ago, for at that time with a +1.50 vision was $\frac{20}{20}$, now the strongest glass accepted is a +5.0, vision $\frac{20}{60}$; the increased tension has lengthened the globe. My advice at the time I discharged the patient was not to use the eye for any close work, and to rest and build up the general health. The habit of years was too much for her and she has been sewing, reading and writing, often to extreme fatigue. This case must be watched very closely, eserine instilled every four to six hours, the tension and visual acuity taken, and if in a few days the symptoms have not abated an iridectomy should be done.

Mr. L. A., comes to the clinic complaining of lowered vision. He says that a month ago he was able to read newspaper print with glasses by holding it far enough away. Now we find that his vision equals only $\frac{20}{200}$, and that he has to make an effort to see even that large letter, by closing one eye and searching his field for an area large and clear enough to get the impression. In the dark room we find that the cornea is clear, the iris mobile and the pupillary space and lens normal. The vitreous, however, is cloudy as though

filled with minute particles and the retinal field covered with patches of exudate, small drop-like hæmorrhages, and areas of blurred and obscured transudates in the region of the ora serrata. The nerve head is normal but the choroidal ring is obscured and the macular region is covered by exudate. The retinal blood vessels are nearly normal in size but irregular in course, and in places obscured by the cloudy vitreous. The cloudiness of the vitreous suggests its being syphilitic in origin. (Fig. 111.) About six years ago the patient had a pri-

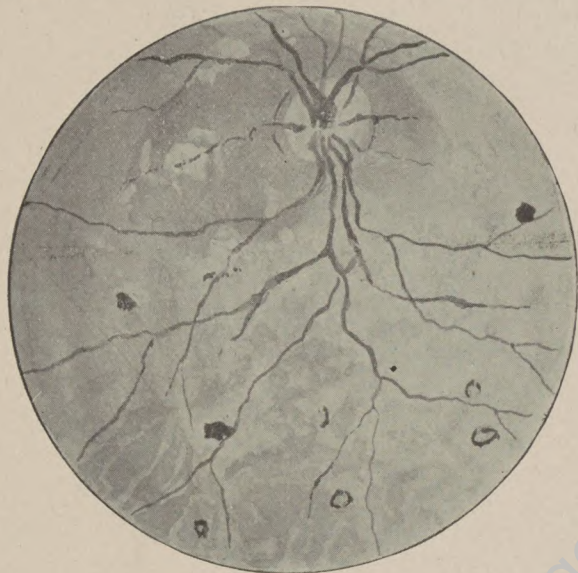


FIG. 111.
Early stage of specific choroiditis.

mary ulcer, and later the skin and throat symptoms for which he was under treatment for seven or eight months. Two years ago he had an attack of influenza and following it lowered vision for two weeks. One year ago he had an ulcer of the nasal septum with perforation, and ulcers on the legs. During the past ten months he has been drinking freely and has been unable to work. His vision became impaired about one year ago. He is now saturated with alcoholics and refuses

even a partial reform even though we assure him of improved vision if he will be faithful to treatment, diet and improved habits. While syphilis is a grave disease and liable at any time to develop serious and fatal symptoms, it is also one of the diseases which responds most quickly and certainly to treatment. An idiopathic choroiditis of equal severity would be considered almost hopeless. The prognosis in this case though not good is favorable to improved vision under the following treatment: Total abstinence from alcoholics, a simple diet, three or four hot baths a week, cleaning the teeth and mouth with a saturated solution of chlorate of potassium, calomel cathartics with a saline laxative every two weeks, and dark glasses worn to protect the eyes from the light. The specific treatment should be inunctions of mercurial ointment two to four drams every night. The ointment should be thoroughly rubbed into the axilla, groin, popliteal space, behind the ears, and into the temples and neck. There is little or no danger to the teeth or of salivation if the mouth is kept clean. General treatment by tonics such as iron, quinia, and strychnia may be instituted as occasion demands. In this case, however, we shall only be able to give him advice, which he no doubt will not follow, and medicines, which he will not take.

Optic nerve atrophy without the history of disease or injury of the eye.

Miss L., aged twenty-four years, about four months ago noticed that her vision was lower than normal and that her left eye was nearly blind, and since that time her vision has become much lowered: R. V. = $\frac{10}{200}$, L. V. = $\frac{2}{200}$. There is a complete white atrophy of both disks and her vision is limited to the macular region. (See Fig. 112.)

To take the field of vision without a perimeter, place the patient with his back to a strong light, cover one eye with a bandage. Place in front of him a screen of black cloth with

a white card one-half inch in diameter pinned to its center and on a level with his eyes. Direct him to fix his gaze without change. You are then to move from the periphery towards the center a card of similar size attached to a blackened stick or wire. Instruct the patient that when he distinguishes the moving card coming into the field of vision he is to indicate it by a movement of the hand; put a mark at the point of arrest, and in this way the entire field can be traced and the record made by measuring from the center to each point on the principal meridians. In this way a limited field of scotoma or blind-spot can also be accurately measured. A

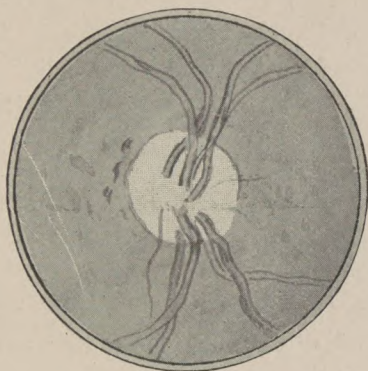


FIG. 112.

still rougher estimate can be made by placing your patient as before and standing about eighteen inches in front of him, then have the patient fix his gaze upon your watch-charm and have him tell you when a small card or pencil head comes into his field of vision.

This patient's vision field we have measured in this latter way and find it contracted, and will now make a chart of it from the Landolt perimeter. The field is contracted in a regular form, the central field alone being able to distinguish white from red or blue. There is no history. The ophthalmoscope shows a perfectly blanched disk with small arteries and veins, and as there are no choroidal changes we can only

suspect that they are due to some general disturbance, which was not noticeable, or at least not noticed; and that she had an optic neuritis without lowering of the vision, which ran its course and the stage of atrophy followed. Similar changes result from intestinal toxæmia, pelvic disorders, hereditary syphilis, acquired syphilis, acute infectious diseases, rheumatism, etc. In this case there is nothing in family or personal history to explain the condition.

There are no special subjective symptoms which are diagnostic of optic nerve inflammation. The ophthalmoscope is the only sure instrument of diagnosis, and it is frequently impossible to determine when the condition is one of hyperæmia or the early stage of inflammatory disease. It is also important that the choked disk of brain or orbital pressure should not be confounded with this condition. (Plate XX, Fig. 1.)

Mr. L. K., aged twenty-four years, about two or three days ago found that he was not able to read the names upon the street corners and the smaller signs on the doors. He also complains of blurring at close vision, and that the paper at times seems to be tinted red. The media are clear but the outlines of the optic disk are almost obliterated by the increase in size of the blood vessels and a thin exudate almost like a veil of gauze. The principal blood vessels are much enlarged and the arteries are especially tortuous. There are no exudates or hæmorrhages surrounding the disk, but near the macula there is a star-like arrangement of exudate and one small retinal hæmorrhage. *The retinitis is characteristic of that occurring in albuminuria.* (Fig. 113.) His hands are fat and puffy and the dents from pressure upon them remain for a long time. There is no history of acute infectious disease, and he is temperate in his habits. About four months ago while engaged in his work he was severely chilled, freezing one hand and foot so badly that amputation was at one time thought necessary. This chilling may have been the cause of



Fig. 1.
Acute Neuritis.

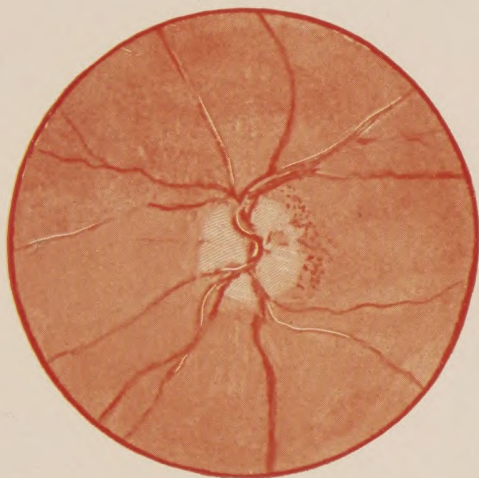


Fig. 2.
Atrophy.



Fig. 3.
Retinal
Hæmorrhage in a
Chronic Alcoholic.

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the nephritis. There is abundant albumin in the urine. We will refer him to the general medical clinic for treatment.

Albuminuria, late stage; retinitis.

Mr. L. C., aged twenty-four, some three years ago was examined for insurance, and albumin was found in his urine. He has been under treatment since that time for the disease which seems to be progressing. His vision is very low in the right eye and he comes to our clinic for glasses to enable him to see to work. The ophthalmoscope shows the fundus of the right eye to be extensively diseased; exudates; hæmorrhagic and degenerated areas. Vision $= \frac{4}{200}$. The disease in the left eye is not so far advanced but is well-marked. The prognosis in this case is very grave. I have rarely known a patient to live more than twenty months after the eye symptoms were advanced to this stage. (Plate XXI.)

May L., aged seventeen, comes complaining of sudden and complete loss of vision in the left eye. The ophthalmoscope shows the disk and retina to be blanched as though the blood supply had been completely shut off (Plate XXII, Fig. 1). There is a hæmorrhagic spot near the temporal side of the disk. This is a case of embolism of the central artery or one of its branches. The probable cause of the embolism in this case is suppression of the menses from taking cold. The patient gives a history of menstruating to the third day, when she was exposed to wet and cold, had a chill during the night and complete suppression of the flow. The prognosis is favorable to a return of vision to a part of the field as the embolism is absorbed. This drawing (Plate XXII, Fig. 2) was made fourteen months later and shows the region of the embolism, the destroyed retina and choroid. Vision is normal except over the region of the choroidal and retinal atrophy where there is a complete scotoma. (Fig. 114.)

Choroidal and retinal changes from anæmia.

Miss T., aged seventeen, has had eye-strain symptoms for several months. She comes for examination and we find that she has a hypermetropia of three degrees giving a vision of $\frac{2}{40}$. The chief interest in this case is the extreme poverty of the blood, and the continued low specific gravity, 1008 to, 1012, of the urine for about two weeks, with neither albumin nor casts. The retina, aside from its central patches of exu-



FIG. 113.

Albuminuric retinitis from a colored drawing.

date and small hæmorrhages is normal. This form of retinitis is more common than the literature of the subject would lead us to suppose. The prognosis, so far as the eyes are concerned, is good and there is no general disease aside from the anæmia. The treatment must be directed to the general upbuilding of the patient and the correction of the hypermetropia, which may have been the exciting cause of the anæmia and the exciting cause of the lesion in the eye. (Plate XXIII, Fig. 3.)

Foreign bodies may lodge in the retina and choroid, and if they are not septic or irritating may become encysted and remain innocuous for an indefinite period.

Mr. K. a glass-worker, was struck by a fragment of glass which entered the eye on the temporal side and traversing the vitreous lodged about midway between the disk and ora serrata. The injury was received about three years ago, and aside from a slight conjunctival hæmorrhage and a small hæmorrhage and exudate at the point of fixation, he has been absolutely free from irritation up to the time of coming to the clinic. The location of the cyst is well made out, as it pro-

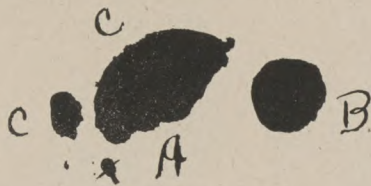


FIG. 114.

A. Macula. B. Blind spot. C. C. Scotomata.

jects into the vitreous about one mm. and is about one-fifth the size of the disk in diameter. About two years ago he allowed me to examine the sclera beneath the internal rectus muscle; there was no evidence of a wound of exit.*

Foreign bodies in the vitreous.

Mr. L., a brass-worker, received a fragment in the right eye. It passed through the cornea and ciliary body and lodged in the fundus between the macula and the disk. It is now four years since the injury and there have been no symptoms of irritation. When the injury was first received the

*This patient five years later lost both eyes from the explosion of a globe on which he was working. The right eye, primarily injured, was found to contain a fragment of glass enclosed in a chalk-like cyst and the sclera was almost perforated.

fragment could be made out as a brilliant point projecting slightly into the vitreous; now there is a discolored area about twice the size of the macula, extending forward and downward, and from it a gray-white tumor projects, no doubt a cyst containing the fragment. (Fig. 115.) There is nothing to be done for this patient as long as there is no disturbance of the nutrition of the eye or irritation of its fellow.

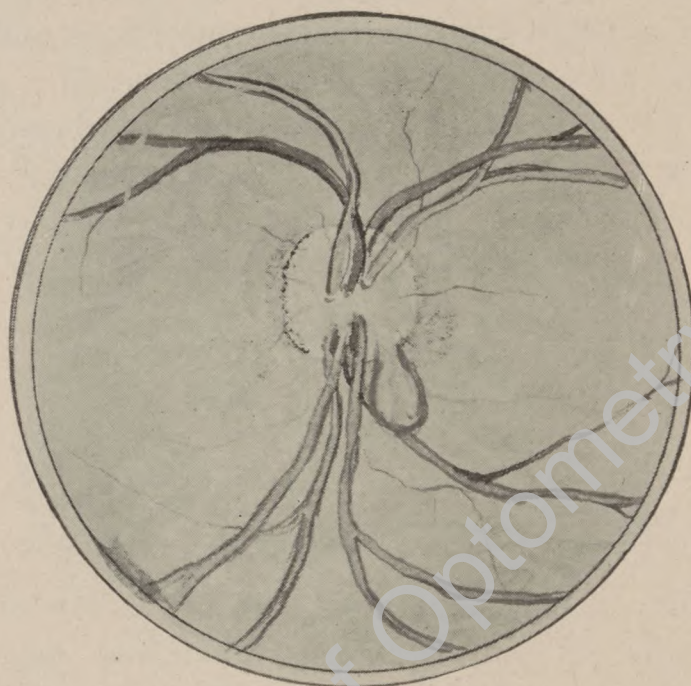


FIG. 115.

Aseptic bodies frequently become encysted and remain in the eye the lifetime of the patient. *Septic or irritating* bodies must be removed as soon as symptoms of irritation are observed.

Mr. L., aged forty-nine, received a fragment of cold iron in his right eye yesterday. The wound of entrance is just to the left of the cornea and is ragged and pouting. The vitreous is cloudy, but I can see a clot of blood filling the temporal part of the field. The eye is very painful and the tension is low. The lens is normal, but the iris is flushed and contracted. I have advised enucleation, but our patient is



Albuminuric Retinitis.

PLATE XXI.

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anxious to have the iron removed with a magnet, as he has known of its being done successfully in another case. I am willing to attempt its removal in that manner, but do not advise it as the best procedure. The eye is flushed with a solution of boric acid and cocaine instilled, the tip of the magnet is introduced into the wound and passed slowly in the direction of the opposite wall; a sharp tick of contact is felt and heard and the instrument is slowly withdrawn and with it a wedge-like piece of iron about six mm. long and three mm. wide. (Fig. 116.)

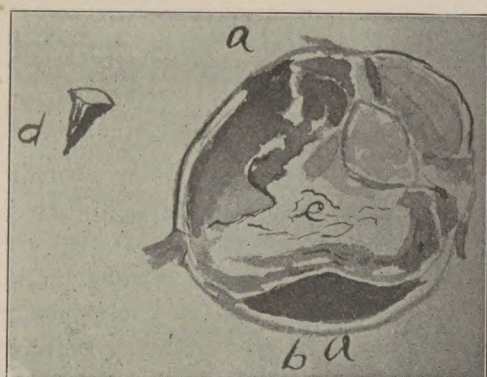


FIG. 116.

Macroscopic section of the eye injured by a foreign body entering on the temporal side. a. Wound of entrance. b. Clot of blood where foreign body was located. c. Pus and disintegrated vitreous. d. Foreign body removed.

The wound is now dressed with a $\frac{1}{2000}$ bichloride solution and a compress bandage applied. The second day the lens is opaque, there is a grayish discharge from the wound and the tension of the eye is much below normal, but our patient still refuses to have the eye removed, though an opiate has been administered every four hours to relieve pain, and an ice-bag used to retard inflammation. Third day, the conjunctiva is distended, the cornea almost covered and the anterior chamber is full of pus. Our patient is now ready for the operation. The eye is enucleated with difficulty on account of the bleeding

and the tension of the eyeball. and the capsule of Tenon for the eye has become generally infected. The wound healed kindly and in about fifteen days an artificial shell was put in position. The spicula of iron was from an old chisel.

Removal of the injured eye is not to be considered *at any time* after symptoms of inflammation are manifested in the fellow-eye, for it often happens as a sequel to the above that the crippled *primary* eye is all that the patient has to depend upon for vision. *Hence the great importance of promptness in operation as a preventive measure.*

The operative procedures which are to be considered are, first, *evisceration*, which may be made if the patient will submit to an immediate operation as a preventive measure, and it may be done in the following manner:

The lids are held open by a spring speculum, the conjunctival sac thoroughly washed out and then filled with a solution of corrosive sublimate $\frac{1}{2000}$. The conjunctiva is then grasped with fixation forceps, a long Graefé knife entered one mm. to the scleral side of the sclero-corneal junction and carried across to a corresponding point on the opposite side, cutting out on a line with the point of transfixion. The corneal flap is then grasped with the forceps and removed with knife or scissors, thus uncapping the eye. This procedure must be modified somewhat by the existing wounds, as they may be extensive enough to materially modify the operation. The cornea having been removed the sclerotic is grasped with the fixation forceps, and a broad scoop or spoon is used to detach the choroid and evacuate the vitreous. The hæmorrhage in this operation is frequently profuse, and ice may be required to prevent delay. After bleeding has ceased, it is my custom to follow the suggestion of Dr. Prince and cauterize the inner surface of the sclera with a ninety-five per cent. solution of carbolic acid, using great care that there is no excess of acid upon the applicator. The eye is then dressed with sutures. The advantage of the operation is that there is less danger of meningitis, and the stump, made by the

retracted sclerotic with all of the motor muscles attached, is more mobile than the one made by complete enucleation.

The operation most frequently made in cases where there has been delay, and inflammatory symptoms have already set up in the injured eye, is *enucleation*, and is done in the following manner:

The lids are held apart by retractors in the hands of an assistant; the eye is firmly grasped by fixation forceps held by an assistant; the operator then picks up the conjunctiva just outside the sclero-corneal junction, and with scissors or a broad thin knife completely dissects away the conjunctiva, keeping as close to the cornea as possible, then sweeping the knife deeper beneath the conjunctiva it is freed from the ocular walls. With the strabismus hooks the muscles are raised, and severed as closely to the ocular wall as is possible, the connective tissue attachments are detached, the eye forced forward through the conjunctiva, and to the nasal side. A pair of properly constructed enucleation scissors are now entered beneath the displaced ball, the optic nerve is to be felt between the blades and cut off about three mm. from the globe, which is now free from its attachments and easily removed. The cavity is then thoroughly washed, all shreds removed, and dusted with amorphous boric acid. No sutures are used, a compress bandage is firmly applied to prevent secondary hæmorrhage; healing is usually prompt, and if care has been taken to keep the eye aseptic there will be no pus. In two weeks an artificial eye can be placed, and is usually more agreeable than the empty cavity to the unsupported lids.

Still another method is followed with the object of retaining the injured eye, and yet severing all connection with its fellow, by an optico-ciliary neurotomy. The external rectus is raised and severed as in tenotomy, the distal end of the tendon secured by a suture connecting it with the conjunctiva. The strong enucleation scissors are introduced, closing upon the optic nerve it is severed at about five mm. from the globe, and all of the ciliary nerves are then divided and the globe

turned outward. The stump of the optic nerve is then severed from the globe, which is returned to its place, the external rectus is reattached, and a dressing is applied. The whole procedure should be carried out under the strictest antiseptic precautions.

The operation above described has been the subject of serious adverse criticism, and certainly if the procedure was properly carried out in some of the cases reported it is not to be depended upon, for reattachment of the optic nerve with perception of light has been reported and cyclitis with neurotic symptoms in the fellow-eye has been observed.

I should consent to the operation only as the last alternative, and after a full explanation had been made that there was no assurance that the eye would not ultimately require enucleation, for, aside from the condition mentioned above as an objection, corneal ulcers and pan-ophthalmitis have resulted.

When the pupil has become blocked by posterior synechia and exudation causing occlusion or obstruction of light or exclusion by shutting off the anterior from the posterior chamber, iridectomy may be made both for visual and drainage purposes, but only when *all active inflammation has subsided*.

The introduction of glass or metal balls to fill out the orbit has not met with the success first predicted for the operation, and I do not advise their use. I have tried with a degree of success the injection of paraffin into the cavity of the orbit after enucleation. So far the results are very favorable.

The selection of an artificial eye (Fig. 117) is the most important matter to your patient, next to the operation of enucleation or evisceration. The points to be considered are: First. The shape and size of the cavity. Second. The stump and its mobility. Third. The color of the eye to be matched. Fourth. The size of the cornea. Fifth. The color of the sclerotic. Sixth. The distance from the center of the cornea

to the inner canthus. Seventh. The width of the artificial globe and the habitual aperture of the eye.

The eye-shell selected should be large enough to fill the cavity loosely but not tightly bound by it. If the shell is too large it is limited in movement and does not allow free play of the lid over it. Select the smallest, well-proportioned eye that will remain in the cavity without danger of displacement or rotation. The color and shade is not so important as the size and shape. An eye that is too long from the cornea to the canthus will appear as divergent. A well-made stump will

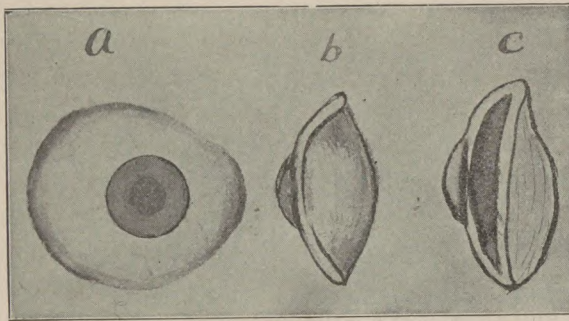


FIG. 117

- a. Front view of artificial shell.
- b. Section of single wall shell.
- c. Section of Snellen, or double wall shell.

allow of quite a range of motion if the shell is not too large. Orbital cavities which are contracted by adhesions, the result of burns or lacerated injuries, are difficult to fit and may require a plastic operation to prepare for the artificial eye. The new Snellen shell, while it weighs more than the single-walled eye, is a great improvement as it fills out the orbit better than the old style one does. The single-walled shell can be ground to fit irregularities of the conjunctiva.

You must instruct your patients about the care of the shell, to keep it clean and well-polished. I have found that by rubbing the cornea on fresh blotting paper it will keep in

good lustre. Always sterilize your shells in a twenty-five per cent. solution of carbolic acid before using them in fitting your patient, for you cannot know into what infected cavities they have previously been placed. Instruct your patient to depend on rotation of the head as much as possible, and less on the movement of his eyes, in order to avoid the fixed appearance of the artificial eye, when the fellow-eye is abducted or adducted beyond its limited range.

Tumor of the uveal tract.

Master Van B., aged fourteen years, comes with a tumor of the inside of the left eye. It is about four months since he discovered that by covering the right eye his vision was below normal in the left. He then consulted his family physician, who upon a careful examination of the external aspect of the eye advised him that there was nothing to do for it and that he might have been blind in that eye from birth. A few days ago the mother noticed that there was a dark spot near the cornea and that it seemed to be increasing in area and was becoming elevated. We now find that there is a small elevation near the temporal margin of the cornea about the size of a split pea. The iris does not respond to light and is fully dilated and irregular. Tension +4.

The ophthalmoscope shows that the temporal field is filled with a dark mass which does not allow of retinal reflex except in a small crescentic spot on the nasal side. The mass seems to be irregular in form and highly vascular. From its location in the ciliary region and its rapid growth I should judge it to be a pigment-celled sarcoma and that it might be a multiple tumor. The eye should be enucleated at once, as there is danger of extension to the orbit, if it has not already occurred. Or this may be the parent growth and others may, by metastasis, spring up in other portions of the body.

The parents are willing that the eye should be enucleated, and an anæsthetic will be administered at once. Aside from

the usual care in enucleating we must see that all diseased, or possibly diseased, tissue is removed. The operation will be rather an amputation than an enucleation. As I desire to remove the conjunctival lymphatics the entire ocular conjunctiva will be removed, the nerve cut off near the ball and the orbital cavity carefully searched for growths along the nerve or at the apex. Nothing is found to indicate that there has been any extension of the growth to the orbit. I have filled in the conjunctiva by taking a pedunculated flap from the temple to make room for an artificial eye. A section of the eye shows a large tumor filling the temporal three-fourths of the globe.* (Fig. 118.)

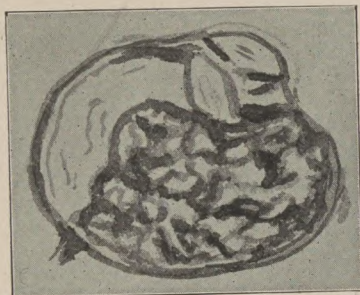


FIG. 118.
Pigment celled sarcoma of the ciliary body.

The vitreous is subject to modifications of nutrition and may by shrinking cause detachment of the retina with serous deposits or choroidal hæmorrhage.

Mr. K., aged thirty-nine, journeyman tailor, has had troublesome eyes from early youth. He is myopic, using a — 8d. for close work. Three or four days ago he noticed that he was troubled with flashes of light in his left eye and yesterday could only see objects to the temporal side, and even these were obscured. The vitreous has been for years

* Nothing is known of the subsequent history of his case.

obscured by floating bodies and he thought that one had formed of unusual size. The right eye requires -18 , to give him $\frac{20}{60}$ vision. Eyes prominent, cornea almost conical in appearance, iris normal and no adhesions or deposits on the lens. (Plate XXIII, Fig. 2.) There is a large posterior staphyloma to the nasal side of the disk; the macula is pigmented and the fundus shows evidence of progressive myopia.

The vitreous is clouded near the ora serrata and two or three long festoons obscure the upper portion of the retina. (See Plate XIX, Fig. 4.) The vitreous is fluid, the tension is minus 1.

In the left or blinded eye there is no sign of retinal disease; strong oblique illumination reveals a bluish-green substance floating in the posterior chamber. The ophthalmoscope shows that there is a detachment of the lower temporal third of the retina. The cavity behind it is filled with fluid, for with every movement of the head it is thrown into undulations. The retinal blood vessels are clearly traceable upon its surface. The fundus is obscured by a vitreous filled with dust-like particles.

Detachment of the retina is a very grave condition even when it occurs in an eye less diseased than is this one. Myopes of high degree are liable to detachment, especially if they are doing close work. From chronic inflammation of the uveal tract, especially the posterior portion of it, the vitreous is liable to become fluid, less in quantity than it should be, and the diseased retina to become separated from the choroid, either by serous or plastic exudate, or by the rupture of one of the capillaries and being dissected away by hæmorrhage. The prognosis in this case is very grave. It is more than likely that the entire retina will become detached. The low condition of the general health of our patient does not warrant the use of diuretics or diaphoretics, nor are they indicated in this case. I shall inject into the posterior chamber and the cavity of the vitreous a sterile salt solution one per cent. and put the patient upon a generous, but fluid, diet and keep him



Fig. 1.



Fig. 2.

Embolism of Central Artery.

PLATE XXII.

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in bed for several days, repeating the injection in three days if the condition of the eye warrants it.*

Mr. T., aged eighteen, came to our clinic about eighteen months ago to be refracted. Myopic vision $\frac{10}{200}$ corrected with —1. —2. cy. ax. 180, each eye. He returns to us to-day complaining of pain and sudden loss of vision in both eyes. He had discarded his glasses because he did not care to be confined to their use. Aside from the school work he has been doing bookkeeping at night to pay his way in school. For some time he has been conscious of disturbance of vision, small particles (*muscae volitantes*) floating across his field.

A small, web-like form became a fixed shadow on the printed page and flashes of light would trouble him in the darkened room. Then he noticed that a small, dark spot appeared near the word or object at which he was looking, this increased in size until he became alarmed and returned to us for attention. Both eyes are slightly flushed, irides slightly dulled and pupils dilated. Vision is $\frac{4}{200}$ with the correcting glasses given at the first examination.

Ophthalmoscopic examination. Media clouded and with every movement filled with floating particles, the temporal sides of both retinae are detached from a point near the macula as the membrane floats about with every movement of the eyes. The exudate must be a thin fluid and not a plastic one. I shall put compress bandages upon the eyes, administer hypodermics of pilocarpine and restrict his ingestion of fluids. Should these measures fail I shall inject a sterile normal salt solution into the vitreous cavity of one eye and detach the ex-

* Third day, tension of the eye has improved, and the vision remains stationary. Tenth day. Tension of the eye good, vision improved and patient left hospital. Two months after discharge from the hospital the patient returned with complete detachment. The eye was enucleated four months later.

ternal rectus of the fellow-eye and puncture the sclerotic as nearly as I can in the detached area.*

Detachment of the retina is one of the gravest conditions with which we have to deal. The prognosis is always unfavorable, and there is no well-outlined treatment to guide us in the management of our cases. Detachment with high tension seems to indicate a serous or plastic exudate or a hæmorrhage. Detachment with low tension suggests that there is a shrinking of the vitreous.

The vitreous body is enclosed in a structureless envelope, the hyaloid membrane. The vitreous is free from blood vessels and nerves; it receives its nourishment from the ciliary body and processes. It is subject to disease and injury in connection with its nourishing membrane and surrounding structures. It may become fluid, cloudy or semi-solid, or during protracted proliferating disease of the surrounding parts, blood vessels may extend into it. Loss of substance is very slowly replaced. By shock or concussion it may become disorganized and light be imperfectly transmitted. It usually, however, is quickly reorganized. It may receive a foreign body and hold it suspended for a time when it (the foreign body) will gradually settle to the floor of the eye. A hæmorrhage from the ciliary region may slowly fill the chamber and cause complete destruction of the body.

Mr. K. V., aged sixty-four, a deck-hand, intemperate in his habits, after a prolonged spree found that the upper field of the right eye was totally blind. To-day we find that the tension of the eye is above normal, the anterior chamber shallow, the lens displaced forward and the posterior chamber

* The injected eye improved for a short time then relapsed and total detachment resulted. The eye in which the puncture was made improved as long as I kept the patient under observation, and when last seen had a vision of $\frac{20}{180}$ with correcting lenses.

nearly half filled with blood. The anterior portion of the clot is dark, but the posterior nasal portion is of recent deposit and seems to be elevated more than the temporal side. (Plate XX, Fig. 3.) Bromides and ergot were administered, and ten days later the eye was stony hard and completely filled with blood. He has continued his drinking and I have advised him to apply to the Washingtonian Home for Inebriates for care and attention.

Mr. G. V., aged thirty-eight, myopic from childhood, complains of confusion from flashes of light, especially at night in artificial illumination. He has been refracted. Ophthalmoscopic examination shows a choroiditis, fluid vitreous, and every movement of the eye accompanied by a shower of cholesterine crystals. There is no local treatment for this condition. The proper correction of his error of refraction and the improvement of his nutrition and elimination may to some extent improve his vision and free him from the crystal shower.

Glioma retinae, round and spindle-celled sarcoma, is one of the rather rare diseases of the eye and one of the most to be dreaded. During a service of about ten years in the Illinois State Eye and Ear Infirmary, one year in the Cook County Hospital and four years in the Central Free Dispensary, I saw seven cases in various stages. Five cases came under my care and are reported as follows:

It is rare to see a case in the earliest stage, unless the patient be undergoing examination for some concomitant ailment, and thus an accidental discovery of the glioma be made; for there may be no history of any particular disturbance of the eye.

The first local indications of the disease are the staring, wide-open appearance of the eye, the dilated pupil, and, on close inspection, the presentation of a bright yellow or whitish mass occupying a more or less central position in the pupil-

lary field. Further examination will disclose more or less increase of ocular tension and not uncommonly slight dullness of the cornea. Later the tension is great, the eye congested, and a pink sclero-corneal zone is strongly marked. The tumor presses upon the iris and lens, displacing both, and filling the pupillary field. Through the dull cornea you will be able to notice that changes have taken place in the contour of the tumor, it having become more vascular and less symmetrical than formerly; and finally, if the eye is not enucleated, the cornea will become roughened and soon ulcerate, the eye discharging. The mass increases in size quite rapidly, and, proliferating, evicts a most offensive pus; the orbital structures become involved, and extension to the brain, or exhaustion, soon terminates the case in death. It is not until the cornea becomes involved that there is much manifestation of pain.

The conditions with which malignant tumors of the interior of the eye may be confounded, are: 1. Detachment of the retina; 2. Persistent hyaloid artery; 3. Partial dislocation of an opaque lens; 4. Hæmorrhage with or without detachment of the retina; 5. Lymph deposits posterior to the lens; 6. Lymph and tuberculous deposits.

It would seem, from a review of the experience of the various observers, that a small percentage of all the cases operated are happily terminated by non-recurrence. There is a direct relationship existing between an early operation and the percentage of recoveries. A hopeful prognosis, therefore, will depend entirely on an early diagnosis and decisive action. *Free enucleation must be the immediate procedure*, carefully exploring the cavity of the orbit for any nodules or evidence of an extension of the disease to the optic nerve or the tissues of the orbit.

Glioma retinæ is essentially a disease of early childhood. It may appear as a small tumor situated in any part of the retina, pressing forward and encroaching on the cavity of the vitreous. Secondary masses may arise in more or less widely

separated localities, or they may develop about the primary tumor. It is a malignant growth and histologically resembles a round-cell sarcoma, having its origin in the neuroglia or supporting tissues of the retina. It is composed of granular round cells, with large, spherical nuclei, pressed one against the other and cemented together by a small quantity of intercellular substance.

Other cellular structures may be present and the large-cell tumors are extremely vascular. The growth invades any tissue of the eye or orbit and destroys it with great rapidity. In rare cases it may attack eye, orbital, and brain tissues simultaneously, or it may extend to the brain through the optic nerve or the structures of the orbit. At times the growth may seem to be arrested in its development and undergo degenerative changes.

C. M., age four months; six weeks after birth mother noticed the eyes presented a strange appearance. Child was brought for examination to the Illinois State Charitable Eye and Ear Infirmary in May, 1884. The tumor was plainly visible without the aid of extra illumination. It completely filled the cavity of the vitreous, pressing the iris well forward and rendering the anterior chamber very shallow. There was no appearance of change in the iris, cornea, or conjunctiva. The tumor obtruded forward as a yellowish, rather brilliant mass. Family history: Father had syphilis, had epithelioma removed from his face. A paternal uncle died of hepatic carcinoma. The mother was forty-eight years of age at birth of child.

The eye was enucleated at once and our diagnosis of glioma retinae confirmed by microscopic examination. The parents were warned as to the danger of recurrence, and requested to return with the child once in two or three months. Up to May, 1889, no recurrence. (Fig. 119, Case 1.)

C. E., age three years. In September, 1886, was presented at the Eye and Ear Infirmary. I found a phlyctenular conjunctivitis. Eight weeks later, in a subsequent examination I marked the left eye's indifference to the approach of my hand. In the dark room I discovered a small tumor just

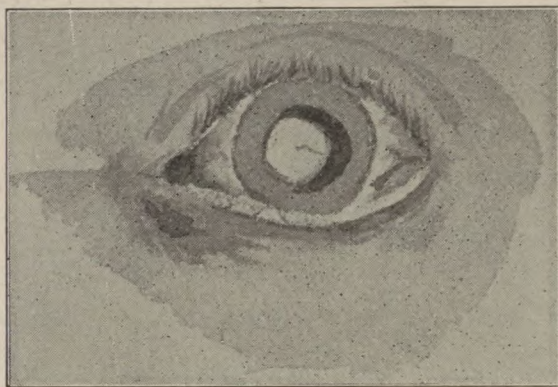


FIG. 119 (a.) CASE I.
Glioma retinae.



FIG. 119 (b.) CASE I.
Glioma retinae.

to the right of the macula. Family history negative; diagnosis, glioma. The mother consented to an immediate enucleation. Microscopic investigation confirmed the diagnosis. September 10th, 1888, the child was returned and the stump found in good condition and an artificial eye placed.

Mary H., aged six years. May, 1897, lost left eye from keratitis at three years of age. There seemed to have been a panophthalmitis. Right eye dull and lustreless, pupil dilated, and capsule of lens marked by former synechia. With aid of ophthalmoscope found small tumor at the disk, the retinal blood-vessels coming from beneath; there was no present evidence of inflammatory action. (Fig. 119, Case II.) Advised an immediate enucleation; friends asked time for reflection; did not return for two weeks, then an increase in size of tumor with some protrusion of the eyeball. The eye was

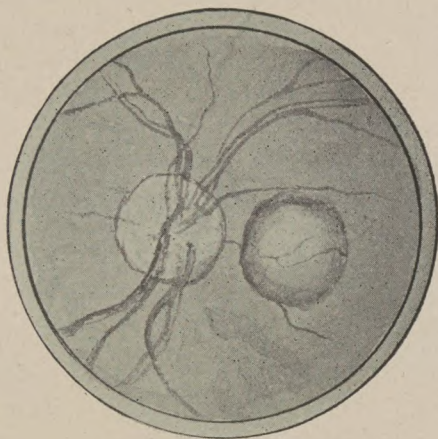


FIG. 119 (c.) CASE II.
Glioma retinae.

enucleated and nerve severed as far back as was possible. Two small nodules were found upon the nerve about five mm. from the ball. Family history unobtainable, as the mother died shortly after the birth of child and father was unknown.

With microscope found numberless spindle-shaped cells, as well as the round cells of the glioma proper. In some of the soft mass there were great numbers of pigment cells. The cavity did not heal, but at once began to extrude proliferating material. Tumor was evidently of a mixed variety.

The child died during the following July with symptoms of meningitis.

John C. C., aged eight months, presented for examination at the clinic, with a large tumor filling the right orbit.

At six months of age, the child was found by the mother to be blind and that there were yellow spots in each eye. Family physician examined child and pronounced it double cataract and suggested an operation to restore sight as soon as convenient. Two months later parents, observing change going on, again consulted the physician, whereupon he wrote to me for advice. The anterior chamber at this time was nearly obliterated and there were evidences of inflammation of the anterior structure of the eyeball. I ventured a diagnosis and a grave prognosis. The parents brought the child to me, and I found even a greater progression of disease than I had anticipated; there was unmistakable evidence of infection of the orbital cavity and beginning cerebral disturbance, so that I could not advise an operation.

Another case was similar to the preceding one, except that the brain symptoms were developed before the tumor had altered the shape of the eyeball. The physician in attendance at the time of my examination suspected that the brain symptoms were due to ear disease, as there had been a chronic discharge from that organ for some months, and that the blindness was due to cataract. The child had spasms and died after a protracted coma, the glioma retinae having developed rapidly.

Two cases additional were in an advanced stage of the disease before they came under my observation.

The case which we have for study to-day is an infant twenty-two months old. Both of its eyes are involved. The parents observed that the child was gradually losing interest in objects about her, and that the hand passed quickly before



Fig. 2.

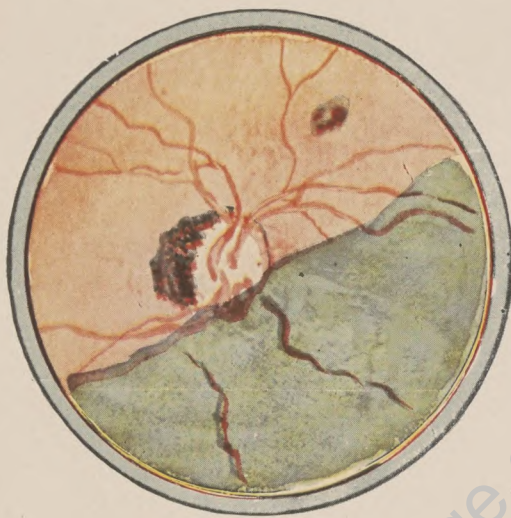


Fig. 2a

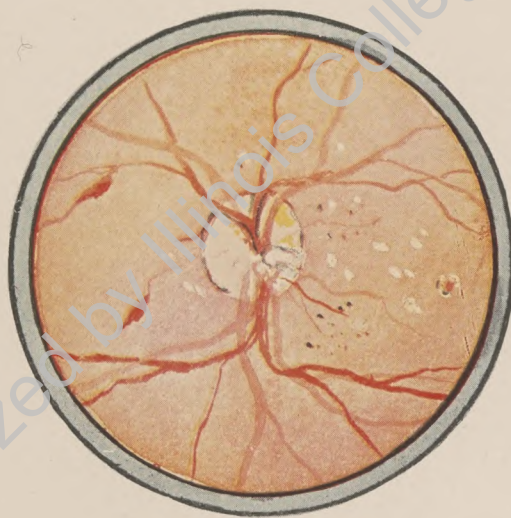


Fig. 3.

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the eyes did not cause winking. Ophthalmoscopic examination reveals a tumor in the back part of each eye. (Plate XIX, Fig. 2.) The growth now fills about one-fourth the cavity of the globe and appears as a yellowish-white mass with blood vessels traversing its surface. The retinal reflex can be seen to one side of it, though the fundus can not be made out. The eyes are very tense and protruding, leading us to suspect an extension of the disease to the orbital cavity. If the orbit is invaded along the course of the optic nerve the condition is hopeless. The most that can be done is to enucleate both eyes, and if the nerve is diseased to excise it, together with all of its surrounding tissue. The removal of the eye accomplished we find several nodules along the course of the nerve almost five mm. in diameter.

The cavity of the orbit is thoroughly curetted and a ninety-five per cent. solution of carbolic acid applied to the cavity, which is then thoroughly packed with iodoform gauze and a firm bandage applied.

The prognosis is most grave.*

The choroid is not subject to any direct traumatism which does not involve other portions of the eyeball. It is, however, liable to indirect injuries.

This patient, a boat-hand, twenty-three years of age, while doing work about a boat was struck by a broken rope causing extreme ecchymosis and severe pain which lasted for several hours. After the swelling subsided enough to allow the eye to be opened he found that the entire upper field was totally blind and that the lower field was somewhat obscured. The anterior portion of the eye is uninjured though there is some œdema of the conjunctiva. The cornea is clear, the iris is dilated and responds to light, the lens is in position, the vitreous is not clear and the lower portion of the anterior

* The patient died three months later from brain tumor, the orbit filled in and was completely cicatrized before the child's death.

chamber is filled with blood. Just above and to the temporal side there is a ragged, irregular line in one place showing the sclerotic. The blow was sufficient to rupture the choroid, but from the tension of the eye, which is above normal, I judge that the sclera did not give way. Had there been a rupture of the sclera, the tension would be below normal. The active hæmorrhage seems to have subsided because of the intraocular pressure. The prognosis is favorable though the vision will be impaired and there will be a blind spot, or scotoma, including the area involved in the rupture. The treatment will be rest in the recumbent position, saline laxatives, and potassium iodide in fifteen grain doses three times a day. The tension, should it continue in an adult or person beyond middle life, would need attention after danger from further hæmorrhage had passed, for the pressure would cause disturbance in the nutrition of the optic nerve and retina and produce all of the results of true glaucoma. In youth the coats of the eye are elastic and absorption prompt, hence the danger from increase of tension is not so great. (Plate XXIV, Fig. 1.)

The first of these drawings was made at the time of the patient's first visit; the second one about two years later. The field of vision was taken at the time of the second drawing. Central vision is impaired, but the peripheral field is about normal. The absorption of the clot was slow and the return of vision over the field now in use was accomplished in about eight weeks. (Plate XXIV, Fig. 2.)

Master T., ten years old, was wounded in the left eye by a shot from an air-gun. The shot was found lodged in the superior cul-de-sac of the conjunctiva. It struck the eye just at the equator and above the external rectus muscle. There was but little extravasation of blood and a small water-blister at the place of impaction. The injury was received about fourteen days ago, and the parents supposed that the visible wound was the only harm done to the eye, but the boy discovered that he was blind in that eye.

We find to-day that there has been a partial dislocation of the lens downward, a rupture of the iris from its peripheral attachment, and that the retina is detached by a hæmorrhage, the result of the rupture of the choroid, extending from near the ciliary process to the macula. I cannot make out a rupture of the sclerotic coat, though it may have occurred. The iris is widely dilated and slightly tremulous. *A tremulous iris always suggests dislocation of the lens.* The lens is slightly opaque. This condition may be the direct result of the injury

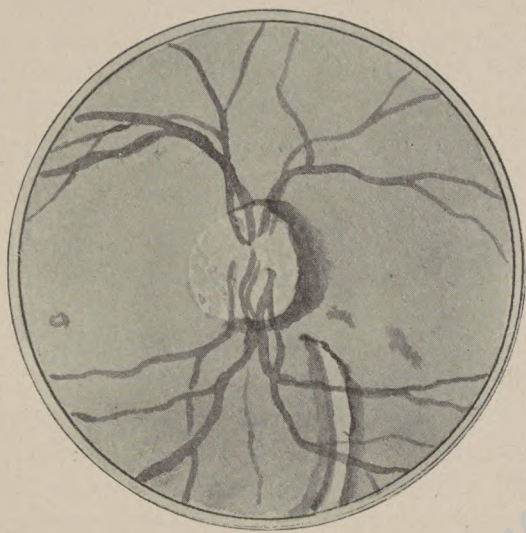


FIG. 120.
Choroidal rupture.

or due to the lowered nutrition from its displaced position. I shall advise the use of eserine to contract the iris and support the lens, so we shall wait to observe changes which may take place.

Six days later. The lens is markedly opaque, the tension of the eye equals plus three, and the iris displaced forward in its lower part. Atropia is instilled, and the pupil dilates fully. The lens is much enlarged and resting against the iris, partially tilted forward. The eye is painful and slightly flushed. On

the eighth day, the lens seems to be softened throughout, so chloroform is administered and a broad Graefé knife passed through the cornea into the presenting portion of the lens,—the milky lens substance rushing forward and filling the anterior chamber. The knife is then rotated and the lens substance slowly makes its way out. The wound is cleansed and the eye dressed as for cataract extraction. Atropine is continued, following the operation.

Ten days later the eye is normal in appearance and tension. The choroidal scar is shown in the drawing, Fig. 120. Vision with a plus 8 equals $\frac{10}{200}$. The prognosis is favorable so far as the retention of the globe is concerned, but vision is lost and the chances are that the eye will not develop with the other and may become atrophic, but there is no danger to the other eye.

Choroiditis may occur during, attacks of gout, rheumatism, syphilis, pyæmia and eruptive diseases.

Mr. S., forty-two years of age, a bookkeeper, doing, however, but little close work and taking no active exercise. He is five feet seven inches in height and weighs one hundred and eighty-eight pounds. He drinks beer at meals and before retiring. Has gouty hands and feet. About sixteen months ago he had an attack of acute articular rheumatism and catarrhal conjunctivitis and the lids are now in a state of chronic irritation. They are filled with concretions and the Meibomian ducts are distended with secretions. About a week ago he found that he could not see clearly the object at which he directed his gaze, and that the central vision of the left eye was obscured. He thinks that the scotoma has increased in extent and density. Ophthalmoscopic examination reveals a subretinal exudate about one-eighth of the disk in diameter. The area is slightly elevated and the choroid blurred and indistinguishable for some distance about it. (Plate XXV, Fig. 1.) The retina does not seem to be changed in appearance. The

choroidal trouble seems to be a part of the general gouty condition. I shall refer the patient to the general medical clinic for treatment. There is nothing to be done in a special way only to insist upon correcting the error of refraction and that the eyes be allowed to rest from close work until the exudate is absorbed. The treatment advised in such cases is as follows: Total abstinence from the use of beer, tea and coffee, a diet limited to cereals, vegetables, milk, cheese and a small quantity of meat, and fish.

Calomel one grain in one-tenth grain doses every fourth day, sodium salicylate ten grains in water after meals.*

My observation leads me to the opinion that uncorrected errors of refraction predispose the eye to partake of the complications attending this class of diseases. The local after-effect of this form of choroidal disease may be a complete atrophy of the area involved, showing the sclerotic coat, or there may be aggregations of pigment and patches of connective tissue. In the young the exudate is frequently absorbed without leaving a trace of the disease.

Rapid lowering of the vision in a person suffering from hypertrophy of the spleen.

Mrs. H., aged twenty-six, was in good health until three years ago, when she had a relapse after typhoid fever, followed by hypertrophy of the spleen. *Anæmia is profound.* About two months ago vision became impaired. The splenic tumor occupies all of the space up to one-and-a-half inches to the right of the umbilicus. She is referred to our clinic for ophthalmoscopic examination, and we find there are extensive plastic exudates and retinal hæmorrhages. The exudates surround and follow along course of the arteries, and the hæmorrhages occur near the venous trunks and seem to be projected

* The deposit was cleared up quickly and vision $\frac{3}{80}$ taken about thirty days after the first visit.

into the vitreous, diffusing through it. The lower portion of the fundus is obscured by debris. The tension of the eyes is —2. (Plate XXV, Fig. .)

The early manifestations of choroidal disease are all so much alike that the general history and condition of the patient will determine your diagnosis.

Syphilis is by far the most common cause of choroiditis.

This patient, C. F., aged twenty-two years, contracted syphilis three years ago. He had no regular attention, but was treated for a short time during the initial symptoms, and about eighteen months ago for an acute iritis which left both irides firmly attached to the lens, but did not cause greatly lowered vision.

About ten days ago his vision began to lower until now his central field equals $\frac{20}{200}$ with several small scotomata scattered about the field.

The vitreous is not clear, but there are no floating masses.

(Ophthalmoscopic examination, Plate XXIII, Fig. 1.)

This condition would not differ much if it was due to any of the septic states. So far as the prognosis is concerned it is favorable if the treatment be thoroughly carried out. (There is one thing in favor of syphilis, as a rule you can obtain definite results from treatment.)

In metastatic choroiditis from measles, scarlet fever, erysipelas, ulcerative pericarditis, tumors, and conjunctival deposits (Plate XXVI, Figs. 1 and 2) the diagnosis can only be made with an ophthalmoscope. This is true of nearly all the early stages of choroidal disease. It is important, therefore, that every opportunity be fully employed to acquire a handling of the instrument and that you become familiar with all of the physiological, as well as the morbid, conditions coming under observation. You will find in all departments of the work that the ophthalmoscope can be employed with benefit.

The patient before us, Mary L. D., aged thirteen years, became blind in her left eye about one year ago. She visited the clinic at that time and I found a tumor near the macula; it projected into the cavity of the vitreous and seemed to be about one-third of the disk in diameter, irregular in form, dark in color, and very vascular. There was but slight increase in tension. The choroid all about it seemed to be irregular, œdematous, and thickened. (Fig. 121.) My diagnosis was choroidal sarcoma and I advised enucleation of the eye and thorough evisceration of the orbit. The patient's

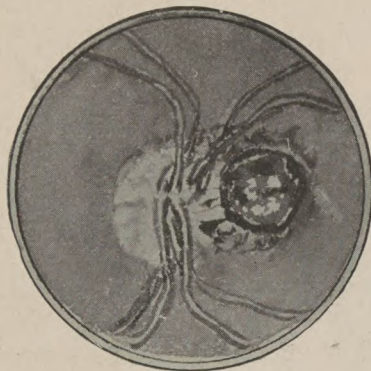


FIG. 121.

parents were not willing to submit the child to my verdict and she has since been the rounds of clinics and dispensaries.

The parents now return with the child and are anxious to have me do as I advised at the first visit. The tumor has been of very slow growth. It is impossible to determine whether it has extended to the orbital cavity or is still confined to the distended walls of the sclera. A malignant growth may extend to the sclera and from there to the orbit, but rarely, if ever, from the orbit to the sclera and its contents. I shall enucleate the globe and examine the contents of the orbit. (Sections of the removed globe shown in Figs. 122 and 123.)

A large pigmented mass occupies the temporal side of

the cavity of the vitreous, the iris and lens are displaced forward, and examination of the optic nerve stump reveals a tumor about ten mm. in diameter, and several indurated masses appear deep in the apex of the orbit. As the prognosis is very grave I clean out all that can be reached with knife and curette.*

Hæmorrhage is usually profuse in cases of malignant tumors which are allowed to develop without operation. An early operation might have saved the child's life. The tumor may have been secondary, the primary growth being in the brain, liver, or some other organ. The operation may have caused a meningitis, though no symptoms other than the convulsions were present.



FIG. 122.

The optic nerve, retina and choroid are so intimately related that it is frequently impossible to determine which structure was primarily involved.

This patient, twenty-eight years of age, eighteen months ago had the initial lesion of syphilis and was under treatment for several months. During the past year he has been suffering from attacks of epilepsy, which are becoming so frequent that he has been obliged to leave his work. About

*The wound did not heal and ten days later the child died during convulsions. An autopsy was not allowed. Microscopic examination of the tumor showed it to be a pigment-celled sarcoma.



Fig. 1.



Fig. 2.



Fig. 3.

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two months ago he noticed that vision was lowered in the right eye and within a few days the left eye became involved. Vision = R., $\frac{4}{200}$; L., $\frac{10}{200}$. He is anæmic, below normal in weight, and drowsy most of the time.

Ophthalmoscopic examination (Plate XX, Fig. 1) shows the media clear, right disk greatly swollen and blurred as though covered by a pledget of carmine-colored wool. Throughout the retina and choroid there are patches of exudate. The iris is sensitive, but there is no asthenopia. The choked disk is indicative of brain tumor, probably gumma, and the epileptic seizures are confirmatory. The retinal disease is not characteristic of syphilis, but in view of the personal history is suggestive; there are nodules on the shins, rheumatic pains, and bald spots on his head, all diagnostic of specific disease. I shall clean out his *prima via* with calomel or blue mass and prescribe:

- | | | |
|----|---------------------------------------------------------------|---------|
| R. | Hydrarg. chlor. cor. | gr. ii. |
| | Potass. iodide, | ʒi. |
| | Aqua dest. | ʒviii. |
| M. | Sig.—A teaspoonful in half a glass of water every four hours. | |

With this I shall advise inunctions of oleate of mercury in the groins and axilla every night; hot baths three times a week; and a simple, nutritious diet without any stimulant, tea, or coffee.

Prof. Patrick referred this child (Plate XX, Fig. 2) from the nervous clinic. She is nine years old and has been in good health. Her vision began to fail about three weeks ago. The eyes appear normal. The family history is not good, being tubercular, and her own history is negative. There is no error of refraction, and with the exception of headache, which has been constant for a few weeks past. The retinal appearance, as illustrated in Plate XXVI, Fig. 1, is not materially different from picture seen with the ophthalmoscope so far as the disk is

concerned, but there the likeness ends, for aside from the hyperæmic condition showing through the general œdema there is no change in the retina. The diagnosis given by Prof. Patrick is tumor of the brain. The choked disk is due to pressure, causing impaired circulation. This condition of the disk usually exists a long time before the symptoms, lowered vision and headache, leads the patient to consult a physician. For want of symptoms allowing localization there is nothing to be done for the relief of this patient. Glioma, sarcoma

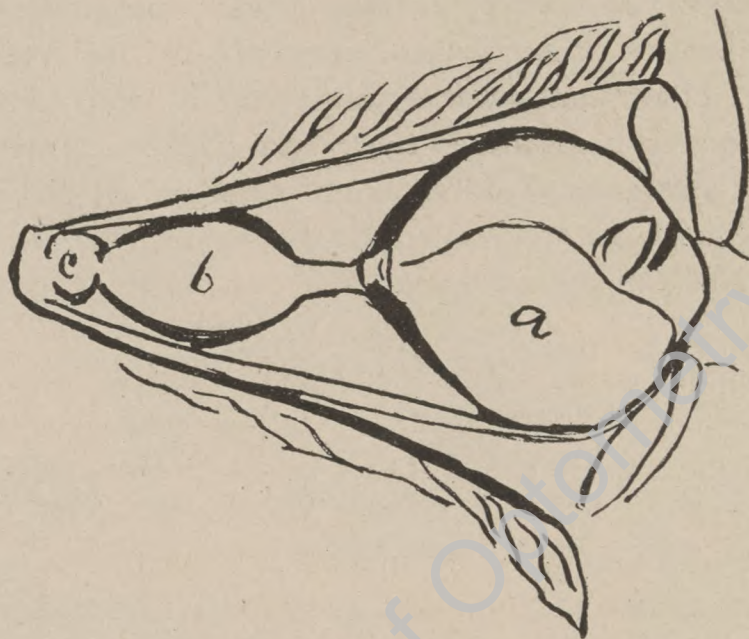


FIG. 123.

Sarcoma of the globe.

a. Intra-ocular tumor. b and c. Orbital tumors.

and fibro-sarcoma are the forms of growth most likely to occur in the brain at this child's age.

Hæmorrhage from the blood vessels of the retina, choroid, ciliary body or iris may take place in patients suffering from gouty, fatty or specific degenerations, or as the result of long-continued traumatic inflammation.

Mrs. O. H., aged sixty-two, has suffered from chronic arthritis for twenty years and all of her joints are more or

less involved. Three years ago she had an attack of partial blindness in the left eye which lasted about six weeks, when vision slowly returned leaving a small blurred spot covering the field of fixation. Yesterday while she was at work she was seized with blindness in the right eye which obscured all of the upper field. The eye is normal in appearance with the exception of the dilated pupil. Tension is slightly above normal.

Ophthalmoscopic examination: The media are clear and at the fundus there is nothing abnormal. The upper portion of the retina is normal except that the arteries are small when compared with the veins, which seem to be unusually large and tortuous. The disk and macula are hidden by an extensive hæmorrhage filling the lower half of the field. (Plate XXVI, Fig. 2.) The clot extends as far towards the periphery as can be seen with the ophthalmoscope. This case properly belongs to the general medical clinic. The prognosis is not good. The vision may improve over a portion of the field as it did in the fellow-eye. The gravest feature in this case is the liability of the degenerated blood vessels to rupture; the next break may occur in the brain or spinal cord and sudden death or paralysis result. In a recent private case a small hæmorrhage occurred in the region of the macula, causing a small central scotoma and the retina was partially detached. The clot was promptly absorbed and in fifteen days only an incomplete scotoma remained. One morning five days later as my patient was moving about the room she fell to the floor and died within fifteen minutes. In more than one case intra-ocular hæmorrhage has been the danger signal. The general treatment of this case is rest, slow, deliberate, movements regulation of the bowels and stimulation of the secretions, iodide of sodium, small, repeated doses of calomel, saline laxatives, with careful diet and a discreet use of stimulants if they have been indulged in prior to the attack.

Toxic amblyopia is the result of retro-bulbar neuritis due to the more or less protracted use of certain toxic agents. Tobacco and alcohol are the most common causes of this condition, though many other drugs, either from idiosyncrasy or from too protracted use, are known to have produced almost identically the same condition.

Mr. L. H., a tailor by occupation, has used alcohol and tobacco from early childhood. The quantity used has gradually increased during the last five years, until now he is fully under the influence of both from one month's end to another. He seldom drinks to intoxication, but frequently takes a number of drams before retiring to insure deep sleep. He can only work, sleep and eat when he is under full stimulation. About three months ago he first noticed that for two or three hours in the early part of the day it was difficult to see to work. Then his vision became too low to do stitching on black goods and he now has been obliged to discontinue employment. He comes to our clinic thinking to obtain glasses to enable him to continue his work. He has all of the evidences of over-stimulation which appeal to sight and smell. I find that he is only able to read $\frac{20}{200}$ with both eyes, and that with the left eye he can only read $\frac{10}{200}$. His vision is much lower than usual to-day, he tells us, as he has had nothing to drink during the afternoon. You will observe that he closes one eye while attempting to read and seems to search his field for an area of clear vision. The pupil does not contract closely to the light of the ophthalmoscope and a mydriatic is not required to render the examination of the fundus easy. The media are clear, the disk and borders obscure and the macula cannot be made out. (Plate XXVI, Fig. 3.) The disk blood vessels are unusually numerous; to the temporal side of the disk the cribriform structure is unusually well-marked and gray, though the total effect is rather a yellowish-gray. The relative size of the blood vessels are arteries, two, and veins, two. The blood vessels seem to be thickened and the refracted



Fig. 1.



Fig. 2.

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lines along their sides almost obliterated. The retinal ground color is a dull orange-yellow. The examination of the retinal field with a Landolt perimeter gives a central scotoma for red, a relative scotoma for blue and green and white and black. The peripheral scotoma for red and blue, and a relative sco-



FIG. 124 (a.)

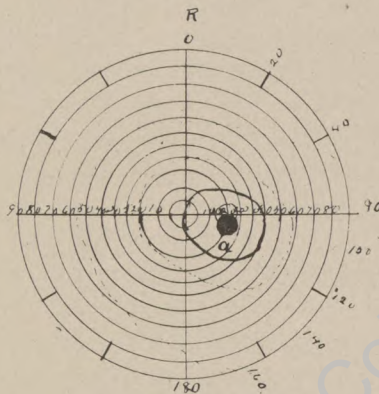


FIG. 124 (b.)

Showing complete scotoma for red.

toma for white and black. The tension of the eye is normal. A hypodermic injection of nitro-glycerine and strychnine improves vision to $\frac{20}{80}$. We have in this patient a chronic inflammation of the axial fibres of the optic nerve; the structural change is not in the form of an atrophy but rather an increase

of the connective tissue structures. Blindness rarely results, though the central field may be totally obscured, especially an oval, oblong area extending from the disk to the *matula lutæ*, and often for some distance surrounding them. The peripheral field may become quite low for short periods. The prognosis is modified by the stage of the disease and the power of the patient to withstand the temptations to indulge his appetite. Central vision in amblyopia of long standing always remains impaired although the color may return to a marked degree. In this case I shall advise a gradual lowering of the quantity of the stimulants used and an improvement in the grade of tobacco, for it is found that the cheaper grades of tobacco contain more nicotine than the Turkish or Cuban tobaccos. I shall advise the use of hypodermics of strychnine and atropine, gradually increasing the dose until the following is taken every four hours:

R Strych. nitrate, grs. $\frac{1}{20}$.
 Atropia sulph., grs. $\frac{1}{50}$.

At the end of the second week tobacco and alcohol should be discontinued, and the dose of the hypodermic gradually lessened when the iodide of potassium and bichloride of mercury can be added to the treatment. I shall expect by the end of the sixth week marked improvement in all of the symptoms. The visual acuity will never become normal and periods of lowered general tone will be accompanied by low vision. It will be of interest to take the field once in four weeks and note the changes as they occur. The urine should be examined once in two weeks, and if the specific gravity falls below normal calomel should be administered in small doses, followed by a saline laxative.

Wood alcohol has come to be used extensively in the mechanical arts, and also as a substitute for alcohol in the manufacture of extracts, such as extract of lemon, vanilla, Jamaica ginger, etc. During the past few years there have

been cases reported of poisoning from drinking these extracts and it was suspected that the ill-effects were due to the base, but later observations showed them to have been the result of the wood alcohol which was used as the vehicle.

Mr. B., a painter and wood-finisher, aged thirty-two years. Up to four days ago he was engaged in redressing a suite of office furniture in one of the large buildings. As the weather was cold the windows were left closed, and as the fumes of the cleaner were objectionable to the tenants, the room was not ventilated into the corridor. After six days' work he complained of pain in his arms and legs, vertigo, and blurring of vision. Two days later, on the eighth day, he was seized with violent vomiting, delirium and increase of temperature; and when he became conscious he discovered that he was partially blind. The object at which he attempted to direct his gaze was obscured, and it was with difficulty that he could move about in familiar surroundings.

Examination of the external portions of the eye reveals nothing abnormal except that the pupil is slightly contracted and does not respond to light. The media are clear and under cocaine the fundus gives the picture of acute neuritis without exudate, disk obscured, blood vessels distended, arteries and veins about the same size. The retinal ground is deeply pink. (Plate XXVII, Fig. 1.)

I shall prescribe the bromides, hot baths, ergot and saline laxatives.

From my experience with a private case, and from recent reports, I shall not expect the return of normal vision, but that following a period of inflammation a white atrophy will result with low central vision, the scotoma well-marked at its center but difficult to outline. Wood alcohol has been used as a stimulant and intoxicant with a large death-rate resulting. I should in the acute stage advise the use of hypodermic injections of pilocarpine, the hot pack and diuretics, in the second stage galvanism, strychnia and the iodides.

Contusions and concussions of the eye.

Mr. C., age fifty-two years, U. S. Railway Mail service, January, 1890, was injured by a blow upon the left eye, causing excessive hæmorrhage, which filled the anterior chamber. The injury was followed by severe pain and inflammation, with general pericorneal flushing and chemosis. Some weeks after the injury the patient was referred to me by the attending physician, and my notes give the following objective symptoms: Cornea normal, pericorneal injection, floating masses in the vitreous, gray opacities and nebulæ of the lens. The clouded condition of the media precluded a clear view of the fundus, which, however, appeared to be markedly flushed. The fellow-eye, the right, was hyperæmic and very sensitive to light. The effort to accommodate was accompanied by pain. Tension in both eyes above normal, pupils somewhat dilated. Eserine, hot applications, potassium iodide and galvanism were prescribed, and later when the active symptoms had subsided and the media were sufficiently clear, an error of refraction was corrected by prescription of proper glasses. The asthenopia and attendant symptoms soon disappeared and vision became normal, continuing so until about the middle of November, when, after some unusual strain the eyes became painfully flushed, tender to touch, and vision dropped to one-third in the left, or injured, eye; media became clouded and floating masses appeared in the anterior chamber, the iris dilated slowly and sluggishly, anterior chamber slowly increased in depth; vision in right eye fell to two-thirds with painful accommodation and a tender pericorneal area. Advised the resumption of the former remedies, with the strict injunction to exclude strong light and to avoid the use of the eyes for any form of close work. The treatment as suggested has been thoroughly carried out for five months, resulting in the clearing of the media, disappearance of all symptoms of inflammation and a return of normal vision. Our patient, however, will not be able to resume his former occupation,

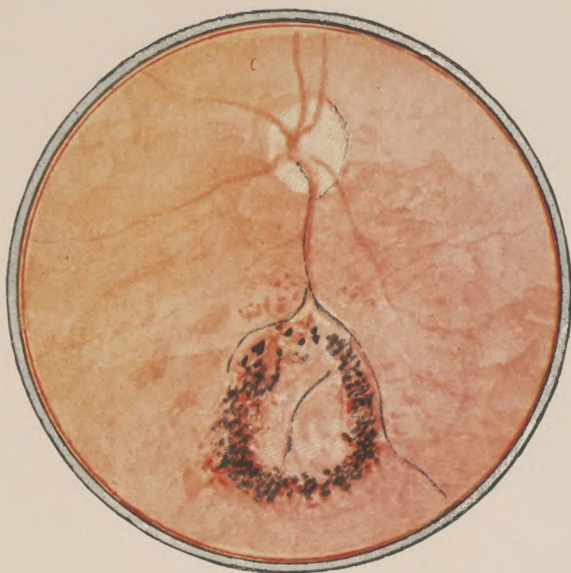


Fig. 1a.



Fig. 2a.

PLATE XXVI A.

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Fig. 2b.

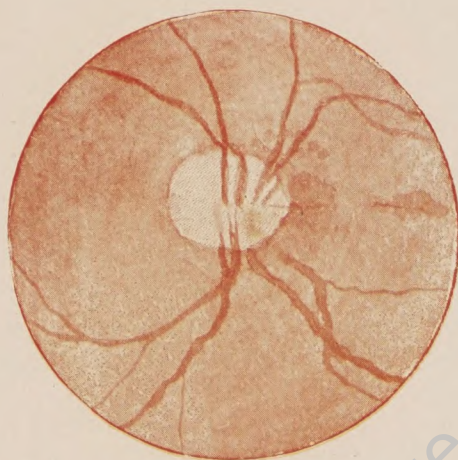


Fig. 3.



Fig. 1b.

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or, in fact, to do any work requiring exact proximal vision. Our diagnosis here would be serous cyclitis in the left eye, and sympathetic irritation in the fellow-eye. Prognosis favorable so long as general health remains good and patient does not overtax accommodation. This case illustrates the history of the favorable termination following concussion.

I will cite the following unfortunate case: Mr. H., dentist by occupation, in arising from a stooping position struck the back of his head against the chandelier, which caused him to suddenly bend forward, whereupon he struck his eye against the back of a chair. This injury was followed by a profuse intra-ocular hæmorrhage and dislocation of the lens. Cyclitis occurred, and continued in a sub-acute form for several months, when suddenly a plastic exudate and sympathetic disease manifested itself in the fellow-eye. The gentleman lived at a distance from a specialist, and he was advised to consult me by his family physician. When he called I found complete occlusion of both pupils with a plastic exudate completely blocking the field. An iridectomy was attempted, but the plastic iritis quickly closed the coloboma, and the result was not favorable. The pain in the injured eye continued to such an extent that we were obliged to enucleate; the uninjured eye continued irritable and painful for some months, when it became quiet, resuming a more normal appearance, but the patient refused further operative interference. As there was no light sense remaining we could not very strongly urge a second operation.

This case illustrates the possible results of a concussion with sympathetic inflammation following in the uninjured eye. It is my opinion that the swelling of the lacerated lens had much to do with the severe pain following the traumatism.

CHAPTER IX.

DISEASES OF THE LENS.

Cataract is the term applied to any opacity of the crystalline lens or its capsule. It may be *congenital*, *traumatic*, or *idiopathic*, and may involve the entire lens or any part of it or its capsule. Congenital cataract is apt to involve only the central portion of the lens and extend from the anterior to the posterior pole, or to the capsule at the anterior pole. (Fig. 125.) The capsule at the posterior pole may be involved separately. There may be one or more rings of opacity surrounding a central opacity. (Plate XXVIII, Figs. 1 and 2.) Frequently children suffering from congenital cataract may have other signs of prenatal deformity of the eyes or impairment of their motility. Congenital cataracts are usually *hard*, or about the normal consistency when portions of the lens are involved, and of the *soft or semi-soft* variety when the entire lens is opaque. In soft cataract the lens is swollen and the capsule distended. If the capsule does not rupture it may shrink later and become irregular in form.

Traumatic cataract is the result of direct or indirect concussion or incision, as from a violent blow over the eyes, or the penetration of the anterior chamber by a sharp implement ruptures the capsule of the lens and allows the aqueous access to the lens substance. (Fig. 126.) Whether the capsule be ruptured or not the lens slowly becomes opaque until the vision is entirely obscured. If the capsule of the lens is lacerated, the lens substance gradually swells, is made soft and is absorbed, leaving behind the more or less opaque and

thickened remains of its envelope. Traumatic cataract occurring after twenty years of age becomes a serious injury on account of the lessened elasticity of the tissues of the eye, and requires immediate surgical interference to prevent the tension becoming so great as to endanger the integrity of the optic nerve and cause impairment of the nutrition to the iris, choroid and ciliary body.

I shall not at this point take into consideration the treatment of traumas involving the lens, but pass at once to the consideration of the idiopathic form.

Idiopathic cataract is any form of opacity of the lens occurring after birth not due to direct or indirect trauma but depending on some form of mal-nutrition, the result of local or constitutional disease. Cataracts have been observed to



FIG. 125.

follow fits or convulsions, mental emotions, debilitating fevers, general mal-nutrition as diabetes, general sclerosis and senile decay. Soft cataract may occur at any age, but more frequently at about forty years.

Hard, or senile, cataract may develop during adult life, but more frequently after the fiftieth year of age. *Soft cataract* is characterized by the uniform milky appearance of the lens, varying in density from partial to complete opacity. *The hard or senile cataract* may begin as a nuclear or peripheral opacity and extend until the entire lens is involved. The appearance is very different from that of soft cataract in that it has marked radiations like overlapping striæ, and varies from pale to dark-amber in color.

I shall not attempt to burden your minds with the terms applied to all varieties of senile cataract, but shall classify

them under the heads of nuclear and peripheral. (Plate XXVIII, Figs. 3 and 4.)

While the immediate cause of cataract may sometimes be obscure and the pathology doubtful, yet there are certain clinical facts that we may take advantage of to guide us in our search for the conditions which cause this form of disease.

It has been observed that cataract follows in certain families from generation to generation, and one would therefore infer that some general condition exists which is hereditary, and predisposes to this disease. Among the most frequent hereditary transmissions are the reproductions of form and feature, and this involves the structure of the eye.



FIG. 126.

Trauma of cornea and lens. Swollen lens matter displacing the iris and filling the anterior chamber.

Hypermetropia and astigmatism are among the common inheritances, and the difficulties of accommodation attending these mal-formations are great and impair sooner or later the nutrition of the eye, and cataract may result. The structure size and habits of certain organs of elimination are always transmitted, and hence we have enfeebled nutrition and gouty and rheumatic tendencies which may favor degenerative disease in the lens. The various forms of toxæmia resulting from drugs, as ergot, toxæmia resulting from insufficient kidney elimination, such as uric-acidæmia or albuminuria, impaired nutrition resulting from arterial changes and the local effects

of disease on the choroid and ciliary bodies, may modify the nutrition of the lens and loss of transparency result. Sooner or later lenticular degeneration follows detachment of the retina, especially in cases caused by hyalitis.

The diagnosis of cataract with our modern instruments is comparatively easy and simple. It is also important that we be able to determine whether a lens occupies its normal position or not. This can be done by taking our patient into a dark room and holding a lighted taper about eighteen inches from the face and on a line with the eye. (Fig. 127.)

The observer will see a small, upright reflection of the light from the cornea, a smaller one farther back in the eye,

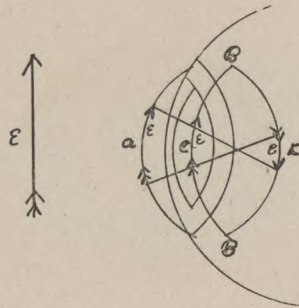


FIG. 127.

- | | | |
|-----------------------|---------------------|----------------------|
| a. Cornea. | b. Lens. | e. Anterior capsule. |
| d. Posterior capsule. | e. Arrow reflected. | |

from the anterior surface of the lens, and a still smaller inverted image reflected from the posterior capsule. If the cornea is clear and the opacity exists in the lens you will be able to determine whether the anterior capsule is involved or some structures to the posterior of it.

The next step in examination is the use of oblique illumination. If the anterior capsule is transparent you will see deeply into the lens structure and be able to determine to some extent the degree and depth of its transparency. (Plate XXVIII, Figs. 4 and 8.) You must also remember, however, that the lens and capsule of aged people are not as trans-

parent as in earlier life. You will notice that the shadow of the iris is thrown to a greater depth in an immature than in a mature opacity; and that the degree of density can be measured with accuracy by this means. *The mature cataract allows no depth of iris shadow.* (Fig. 128.)

The next step in examination is the use of the ophthalmoscope. The light is thrown into the eye from a distance of one meter, gradually approaching the eye, when you will observe a whitish veil obscuring the pupil. The pupil should be dilated with cocaine so as to allow a wide field for examination. *Atropine should never be used until you are satisfied*

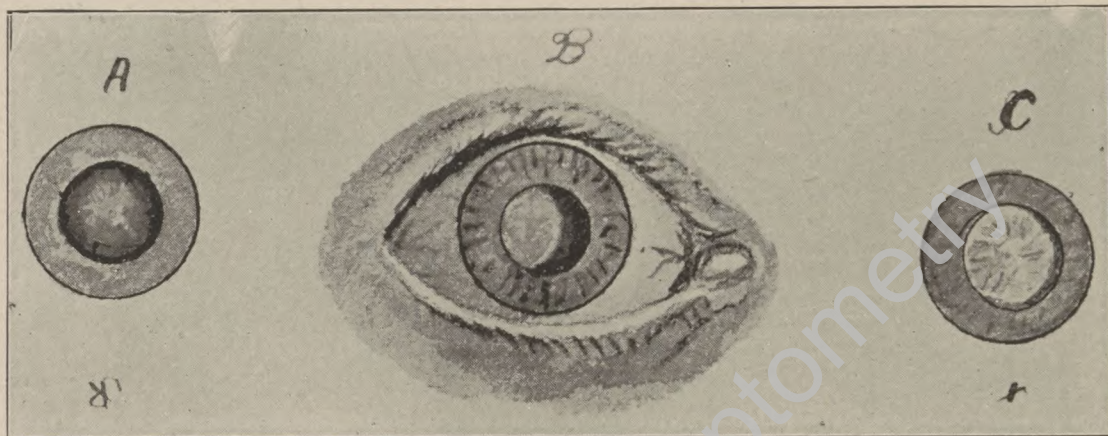


FIG. 128.

- A. Oblique illumination of the lens in the early stage of senile cataract.
- B. Oblique illumination showing deep shadow of iris in an immature cataract.
- C. Shadow of a mature cataract.

that you have a simple case of cataract to deal with and not a condition of glaucoma.

In order to determine that the eye is not glaucomatous the tension should be taken to be compared with an eye known to be normal. In glaucoma the tension or hardness is much greater than in the normal eye. There may be an opaque area about the periphery of the cornea making a partial or complete circle—the *arcus senilis*.

Upon examining with the ophthalmoscope and finding an opacity in the lens you further determine its state and extent

by holding a plus 13d. lens before the patient's eye and study the magnified field to determine the condition of the structure. *The simple nuclear* variety begins at the center of the field and extends in all directions towards the margin of the lens. (Plate XXVIII, Figs. 4 and 8.) *The peripheral* form begins at the zone of the lens and extends inward with finger or spike-like projections. (Plate XXVIII, Figs. 3 and 7.) The spikes may be densely opaque and appear as black lines on a red ground, and are of various lengths and density, extending toward the center of the lens. In the progressive form surrounding the spikes are a nebulae of varying extent.

The nuclear cataract appears with oblique illumination to be an opacity somewhat yellowish in color, occupying the center of the lens (Plate XXIII, Figs. 4 and 8), and with the ophthalmoscope illumination appears to be a dense cloud of black occupying the center of the lens against a red field. There are certain other forms of cataract which are very deceptive in appearance. The dark wine-colored, or mahogany, cataract seems transparent and exists for years without other change than swelling of the lens, and later frequently becoming soft and perfectly transparent, accounting for the miracles (?) of "second sight." Another form presents the appearance of clouds of dust filling various areas of the lens and remaining without change.

The usual course of development is uninterrupted progression from the first signs of lowered vision to total blindness; however, from a large number of cases a few will give the history of interrupted development followed by gradual improvement. I have notes of cases in which lowered vision called attention to the presence of the cataract, an examination was made, careful measurement of the visual acuity taken, and observations showing the extent of the lenticular opacity. With no special treatment, and only attention given to the general health, the patients have gradually improved and the lens clear completely, leaving no trace of the former opacity.

In two cases there were nuclear cataracts; in one general nebular opacity, in the other nebular spikes.

Observations made of the treatment of thirty cases of immature cataract give the following general results: Fourteen cases of nuclear cataract under treatment give three cases improved, eight cases cured, and three cases not improved or benefited. Ten cases of spike-form of cataract: six cases improved and remaining stationary for a period of four or five years, four cases not benefited. The remaining cases were treated irregularly for short periods and I have been unable to secure reports regarding their subsequent condition. Of eighteen cases examined and not treated, I have been able to get reports of but five, four were operated and one is anticipating operation.

My impression from the study of immature cataract is that fully fifty per cent. of the cases, if seen in the first stages, can be arrested in development, and five per cent. can be entirely cured. The remaining cases mature, becoming blind sooner or later. The period of maturing varies from a few months to many years, so in a certain class of cases it would be difficult to determine the value of the treatment. One of the important conditions to which we must give attention is the question of elimination. As many of these conditions first show themselves during or following some acute disease we must look to a systematic course of eliminants and tonics to effect a cure. This is especially true in the various forms of acute gout and allied diseases, uric-acidæmia. Gout in the eye manifests itself in many ways, in the lids, in defective secretions from the Meibomian glands and in the form of Meibomian calculi, Meibomian cysts, chalky degeneration of the lens, degeneration of the iris and ciliary body, and atheromatous degeneration of the uveal tract.

It is our good fortune to-day to be able to examine three cases of cataract.

(Case I.) Mr. B., aged forty-one, was lately discharged from the service of one of our traction companies on account

Fig. 1.

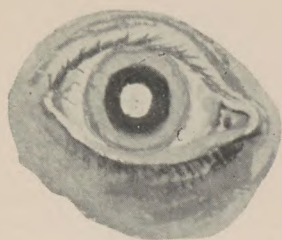


Fig. 5.



Fig. 2.

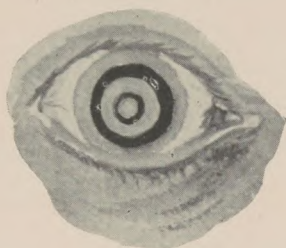


Fig. 6.

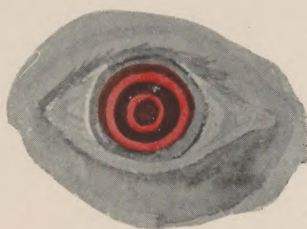


Fig. 3.

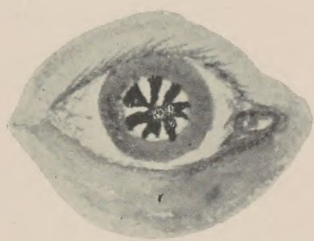


Fig. 7.

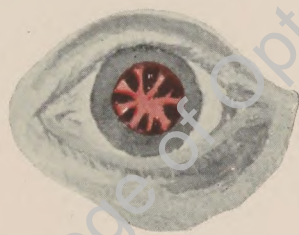


Fig. 4.



Fig. 8.

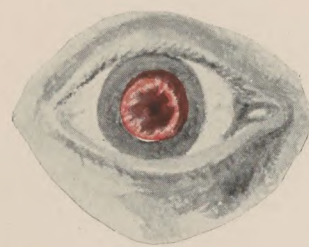


PLATE XXVIII.

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of low visual acuity. This man had been employed for a number of years as an engineer. V. = $\frac{20}{60}$ in each eye. Externally the appearance of the eyes is normal. Internally, with oblique illumination, the cornea and vitreous are normal, but the lens shows numerous spike forms approaching the center from the periphery. The ophthalmoscope allows us to see the retina clearly, and the lines, which appeared as whitish on a black field, now appear black on a red background. You will notice that only a few of the spikes approach the center of the lens near enough to interfere with central vision, and that the clearest part of the field is just above the center of the lens in each eye. The fundus is normal so far as can be determined. The patient gives a history of low vision from childhood, and night-blindness. He had never been subjected to a test for visual acuity until the time of his discharge from service; though he had frequently tried to secure glasses to improve his reading vision. There is nothing in his history that would lead to an opinion that the opacity is not a congenital condition, though the appearance is not the usual one of pre-natal cataract. His vision cannot be improved with lenses. I should advise him to be content with conditions as they now exist. There are no indications for operation.

(Case II.) The next case is also one of lenticular disease—a *senile cataract* in a woman forty-eight years of age. The left eye has been blind since a sick spell occurring about two years ago. The right eye is normal. Oblique illumination: A gray opacity of the lens into which the shadow of the iris does not penetrate. The field of light perception is normal, and the fingers cannot be counted against the window light. We seem to have a ripe cataract, ready for removal. Although the vision is good in the fellow-eye I would advise an operation at an early date; for degeneration is taking place, the lens acting as a foreign substance. We already have symptoms of pain and a slight pericorneal redness, and the tension of the eye is just above that of its fellow. The change which

takes place from this stage on converts it into a hyper-mature cataract, and as time goes on the difficulties and dangers become greater. Every other condition being favorable, it is better to operate early than late. Our patient will present herself on our next clinic day for operation.

(Case III.) Our next is also a case of cataract. This woman is about fifty-seven years of age. About eighteen months ago she suffered pain in the left eye, which continued for several days. The vision became rapidly lowered and she has had intervals of pain since that time. The subjective history is negative, but the objective symptoms are well-marked. The left eye is totally blind, not even perceiving light; the tension of the eye is stony hard. The anterior chamber is totally obliterated; the iris and lens being pressed against the posterior wall of the cornea. The lens is opaque and pearly-gray in color. The cornea is gray and dull in appearance and insensible to the touch. The veins of the conjunctiva are distended and tortuous over the entire ocular portion and at the external canthus are enlarged to a varicose appearance. We have here a condition of chronic glaucoma primarily, and secondarily a cataract. The visual acuity of the fellow-eye is below normal. The tension is +2. Ophthalmoscopic examination does not reveal any evidence of disease, but the history points to early amblyopia; it may have been congenital. In this case the prognosis as regards the left eye is grave. There is no remedy that will avail except enucleation or evisceration for the relief of pain. The lens is opaque as the result of pressure, and the optic nerve, retina, and choroid are atrophic. The condition is one of absolute glaucoma. The safest remedy is evisceration on account of the conjunctival veins and the troublesome hæmorrhage which would be liable to follow an enucleation. I shall not now advise any operative interference with the fellow-eye, but rather the conservative measures. The use of eserine one-half per cent. solution instilled once in every four hours until the next visit;

general tonic treatment, with attention to the *primæ viæ*. Also to impress the patient with the importance of an immediate operation on the glaucomatous eye.

We have to-day for our clinic case No. 2 of last clinic day. The patient presents herself for operation. She has been carefully prepared; first, by taking a free laxative to flush the bowels out, so we can allow twenty-four to thirty-six hours to pass without a movement. Her face and head have been scrubbed, and she has had twenty-four hours in which to become to a degree acclimated and to show evidence of taking cold. She seems in good condition. Two drops of a four-per cent. solution of cocaine will be dropped into the eye every five minutes until complete corneal and conjunctival anæsthesia is secured. The instruments which we shall use have been sterilized and arranged in a tray in the order in which they will be required. The first group contains the speculum, fixative forceps, Graefé knife, cystotome, expulsion spoon, and toilet spatula. The second group are emergency instruments, iris forceps and iris scissors, in case it is necessary to make an iridectomy, a wire-loop and hook to use in case the lens does not present itself, or should fall out of position. A solution of boric acid to occasionally flush the corneal wound is at hand in the event of complicated delivery of the lens, or its fragments.

Though our patient is somewhat nervous I shall undertake a simple extraction, for if at any time a complication arises rendering it necessary the iris can be sectioned. I am fortunate in being able to use my left hand with some precision, so, standing at the patient's head, I can use the Graefé knife in my left, and the fixation forceps in the right hand. The conjunctiva and sub-conjunctival tissues are now grasped just below the sclero-cornea, the Graefé knife enters the anterior chamber by puncture made in the clear cornea at the equator. (Fig. 129.) The knife is directed across the eye and a counter puncture is made opposite the point of entrance. The blade of the knife should now be flat with the iris surface. The

knife by a slight sawing movement is made to cut up, and slightly forward, until about four-fifths of the flap is made, then the cut should be finished with the knife turned gradually until the blade is almost at right angles to the cornea and still well in the clear corneal tissue. (Fig. 130 c. é.) This finishes the corneal cut. The next step is the section of the capsule. Our patient is nervous and not controlling the eye and lid muscles well, so I have withdrawn the speculum and freed the eye from the fixation forceps. I shall now have the

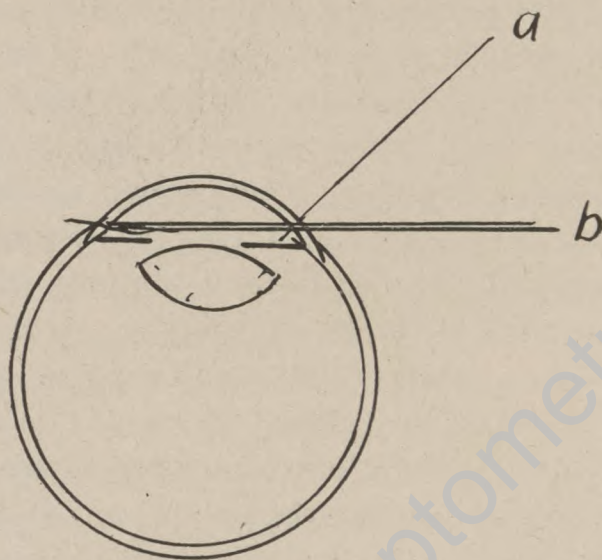


FIG. 129.

Cataract extraction.

- a. First position of knife for making puncture of the cornea.
- b. Second position of knife for counter puncture of the cornea.

assistant firmly retract the lids with his thumbs, one controlling the upper and the other the lower lid, and endeavor to use the cystotome without fixing the eyes with the forceps. (Fig. 131 d.) The cystotome is introduced heel first, passing over the iris to the anterior surface of the lens and a peripheral incision made near the upper margin of the lens. (Fig. 131 B.) The lens is seen to rise forward into the pupillary space as soon as the cystotome is withdrawn. The assistant still controls the upper lid, but has freed to my care the lower lid, which I press forward to just below the margin of the cornea and with a small spoon in the right hand I make pressure on

the upper lip of the wound, slightly depressing it, at the same time making a slight, steady, upward pressure with the left index finger controlling the action of the lower lid against the lower pericorneal region. The lens presents itself in the wound and can be slowly forced into the spoon used to depress the upper lip of the wound. (Fig. 132.) The cornea is bathed with the boric acid solution and the lids allowed to close. This we do to relieve the patient before attempting to remove the cortical matter, and dress the iris into place and form. The lids are again retracted and the wound and anterior chamber

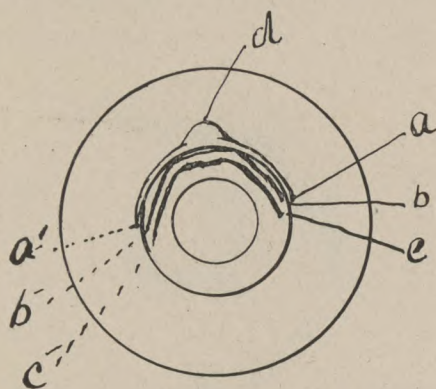


FIG. 130.

- a. a'. Puncture and counter-puncture in pericorneal incision.
 d. Conjunctival flap. b. b'. Low corneal incision,
 c. c'. High corneal incision.

inspected. Small fragments of lens matter can be pressed out by manipulation similar to that used in expelling the lens. Should the fragments which are difficult to reach be engaged in the capsule or beneath the iris you may be able to free them by gently manipulating the eye as in the first stage of lens expulsion. If the particles are not easily coaxed out it is safer to allow them to remain than to prolong the effort to dislodge.

The toilet of the eye should be most carefully made, the iris should resume its position and the pupil become round.

The angles of the corneal incision should be freed from cortical matter and the lids carefully replaced.

Operation for extraction with iridectomy.

Mr. M., aged seventy-eight, in good general health, began the use of glasses for reading at thirty-eight years of age, and for distance at forty-two. Corneal measurement with a Javal ophthalmometer showed compound hypermetropic astigmatism of high degree. His eyes are small and deeply-set. He had an error $+2$ d. sph, and 1.50 d. cy. ax. 90 . *The error*

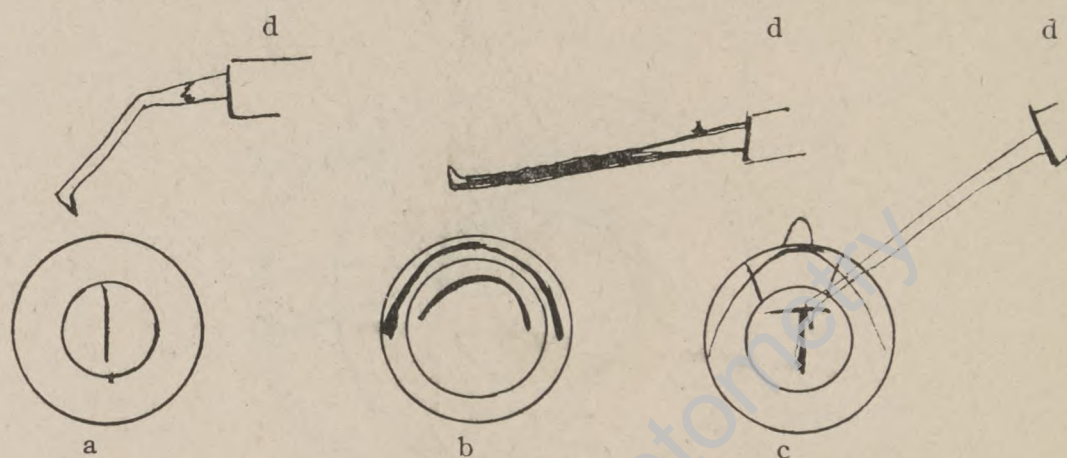


FIG 131

- a. Simple incision of capsule. b. Circular incision of capsule.
c. T-shaped incision of capsule. d. Cystotome.

of refraction and the resulting eye-strain may have caused the opacity of the lens.

Both lenses are matured and the field of light perception is better in the right than in the left eye. On account of the small cornea and almost immobile pupil I shall remove a small portion of the iris. The incision in this form of operation will be made in the sclero-cornea and the flap carried into the conjunctiva, leaving a small conjunctival flap. (Fig. 131 c. and Fig. 130 a. á. d.)

The iris forceps are introduced and a small section of the iris is made, including its circular fibres. The cystotome is introduced and a T-shaped scratch made in the capsule. The lens rises into the anterior chamber with but slight manipu-

lation and is expelled with but small loss of cortex. The patient, with the expulsion of the lens, suddenly moves the eye, but in spite of its being free of the fixation forceps and speculum, which were removed as soon as the corneal section was made, the corneal wound gaped and a small quantity of rather fluid vitreous was expelled, and there was slight bleeding from the iris. The eye was quickly closed and covered with a compress, until the spasm passed off. The eye was then carefully opened and the protruding vitreous excised, the iris dressed into position and the cornea flushed with a saturated solution of boric acid, the conjunctival flap placed in position and the eyes covered with compresses and bandages.

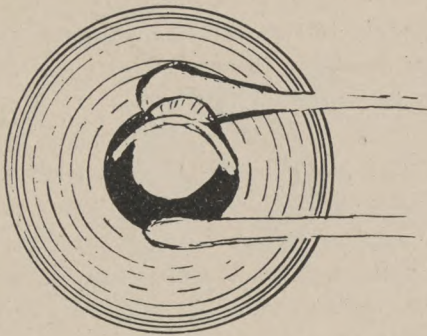


FIG. 132.

The use of atropine and eserine. My custom is to instil two drops of a one per cent. solution of atropine an hour before operating. If the iris responds quickly it is not used again, if not, a second, or even a third, application is made. After the operation, whether an iridectomy has been done or not, I instil two drops of a one per cent. solution of eserine. The atropine is used first to relax the iris and open the pupil. The effect of the atropine lasts from four to five days, while the effect of the eserine is only transient—lasting about twelve hours. The pupil is dilated for the operation; after the operation the eserine contracts the pupil from eight to twelve hours and tends to prevent prolapse of the iris; it then relaxes

and the iris responds to the atropine, dilating the pupil to prevent attachment to the capsule, in case of pressure upon it from the swollen fragments of cortical matter. The lips of the corneal wound very quickly become adherent and by the *fifth day* are quite firmly healed.

In this case the conditions are favorable, the conjunctiva is healthy and the lachrymal drainage is free.

Tenth day, there have been no post-operative complications. Vision with a plus 8 d., and plus 2 cy., ax. 180, gives a vision of $\frac{20}{60}$. The correcting glasses will be prescribed in about four weeks, or as soon as the astigmatism due to the operation has been corrected by repair.

We will find it to the ultimate advantage of our patient not to give him liberty in the use of his eyes until the proper correction can be worn.

A complicated extraction. Dr. C., aged sixty-eight, has a matured nuclear cataract. He has a gouty family and personal history. Atropine was instilled about two hours ago and repeated, and the pupil has responded imperfectly. Our patient is rather nervous and we shall be obliged to take unusual precautions to prevent accidents. The lids are held open by an assistant; the corneal incision made, the iris excised, and the capsule opened, the lids are allowed to close for a moment as the patient is restive. As he becomes more quiet the assistant retracts the upper lid while I use the lower lid to depress the lens and tilt it into the anterior chamber. Just at this point a sudden spasm of the recti muscles cause a gaping of the wound and the lens drops backward, its lower edge only visible, and a small quantity of vitreous is discharged. The lids are again closed and the patient reassured; the lids are reopened under the control of the assistant. I now reach into the eye with a hook, engage the lens and withdraw it. We again have a loss of vitreous and some hæmorrhage from the iris. The toilet of the eye is quickly made and the corneal

and conjunctival flap adjusted; the compresses and bandages applied. Prognosis not as favorable as in an uncomplicated case, but still good. The chief danger comes from infection through the corneal wound, as it is difficult to free it completely from shreds of vitreous, and this is one of the best culture mediums. The introduction of the hook added another danger, even though it was carefully sterilized.

On the fourth day there is some pain and the iris is slightly discolored. Atropine has been instilled at the two preceding dressings. There are two flakes of cortical matter

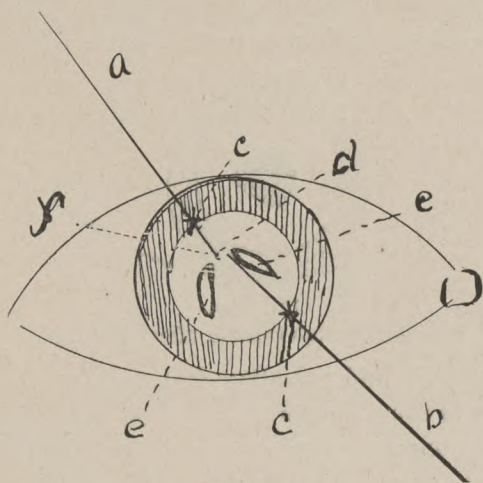


FIG. 133.

- a. c. d. Position of first knife needle. b. c. Second knife needle.
 c. c. First and second incisions made by needle b. f. Isthmus
 cut by knife b.

filling the pupillary space, left from the rather hasty toilet necessitated by the complications attending the operation. Fifteenth day, the eye is quiet, the cortical matter has been absorbed and the iris is adherent to the capsule in two places. The capsule is rather opaque, but this may clear up in the course of the next thirty days. *Three months later*, the membranous cataract is very opaque, the pupil irregular, but otherwise the eye is in good condition. Atropine has been

instilled, and the eye thoroughly cocainized. The patient under a good artificial light, a straight knife needle is entered the cornea, transfixing the capsule; another knife needle is entered to the opposite side of the cornea, the point piercing the capsule to the side of the fixing needle and an incision made in the form of an inverted V (Fig. 133), the apex of the V being severed with the last movement of the needle. (Fig. 134.) The instruments are then withdrawn, atropine again instilled and the bandage applied. Two needles are used to avoid tension upon the iris and ciliary body. The needles should be well selected, the knife just broad enough to allow the cornea to adhere to the shank without allowing

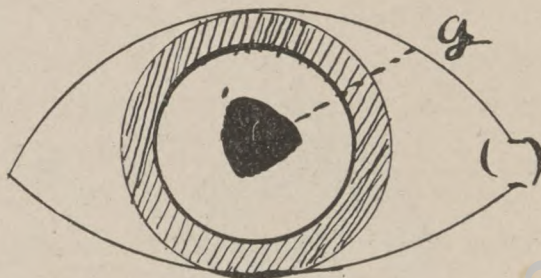


FIG. 134.

Opening through capsule after operation.

escape of aqueous, and yet allow free entrance of the knife. There is always some danger of infection and iritis following the secondary operation and it should be delayed until the eye is perfectly quiet and the patient in good general condition.

Congenital cataract may involve the entire lens and capsule or only a part of it may be involved. The opacity in prenatal cataract may assume any of the forms illustrated in Fig. 125. It may be lenticular, capsular, or both structures may be involved. When the opacity is central and the periphery is clear useful vision may be obtained temporarily by the instillation of atropine, one-half per cent. solution. In such cases iridectomy may be resorted to and the coloboma so placed that a free pupil and fair vision may be obtained.

When the opacity is so situated as to prevent such a procedure being of use the lens can be ruptured and the aqueous admitted to it, it will then soften and be absorbed. This operation is called *discission*.

The case for operation to-day is Master S., aged seven years. He has hereditary syphilis, was a scorbutic infant and is now a nervous, ill-nourished child. The opacity of the lens is irregular in form, from a former attempt at needling. The mother tells me that this was done about two years ago without any favorable result. The light preception is not normal, but there seems to be a good central field. There is some form of retinal degeneration either recent or congenital. The patient is prepared and a knife-needle is thrust into the lens, but it does not enter the capsule and forces the lens backward. Another needle is introduced and forced into the clear portion of the lens, making a partial circuit of the periphery. This procedure was adopted to try and displace the valve-like flap of the capsule, as the lens substance swells. On the fifth day, there has been but slight reaction, the anterior chamber is full of the softened lens matter and the capsule is forced upward allowing a free opening. The tension is high, but the ocular walls of the young are elastic and will not suffer from the pressure. Three months later the child returns with $\frac{2}{80}$ vision without correcting glasses and can read large type of newspaper headings. There is still some capsular substance which must be removed. This I shall do in the following manner: A Graefé knife is introduced as in cataract extraction and in traversing the pupillary space an incision is made through the capsule, the corneal incision is then completed and the capsule and iris withdrawn and excised without loss of vitreous. The wound is dressed, atropine instilled and the eye bandaged. My anxiety is greater now than at the first operation, for all conditions are favorable for an iritis or an irido-cyclitis. We have, however, the fellow-eye upon which to try again to give him

vision in case of failure. Fifteenth day, the recovery as you see has been without complication. As soon as possible we will give him correcting glasses; until then he must wear London smoke coquells of a dark shade.

Extraction of a semi-hard cataract.

Mrs. L., a seamstress, aged forty-two, in fair health, gives the following history: About two years ago her left eye became slowly blind; she consulted a physician who said it was some disease of the optic nerve, as he could see nothing wrong with the eye. Some weeks later she consulted an oculist, who gave it as his opinion that there was an inflammation of the iris and deeper parts of the eye, and treated her for it. To-day, about eighteen months after the first attack, she comes complaining of pain and a sensation of pressure in the eye, with much lowering of vision, for until eight weeks ago she could see fairly well in the temporal field. Oblique illumination reveals an opaque lens slightly swollen, pupil freely movable, perception of light in the temporal field. Tension of the eye plus 1. Eye tender to pressure and deep blood vessels distended and tortuous. Cocaine has been instilled to dilate the pupil and enable us to examine the surface and deeper portions of the lens. The cornea is free from opacity, the anterior surface of the lens is unbroken and shows no sign of injury, the position of the lens is normal. The urine has been examined and found normal. Whatever the condition may have been at the beginning of the trouble I am convinced that there has been a detachment of the retina either from hæmorrhage or effusion, and that the cataract is due to the disease of the retinal and choroid coats. I advise the operation for removal of the lens. It must be done in order to prevent destruction of the eye from secondary glaucoma. If this operation is not done the eye will go on to high tension and a chronic irido-cyclitis result, which will endanger the other eye. The anterior

chamber is very shallow and the lens much enlarged. I shall now proceed to operate in the following manner: A narrow Graefé knife is used to make a small corneal section. (Fig. 132.) The capsule of the lens is ruptured as the point of the knife passes over the lens. The soft matter flows freely. There is a prolapse of the iris, which is removed with the scissors; as there is quite a quantity of lens matter remaining in the eye I introduce a flat-tipped syringe using a perforated bulb (the Dunn dental syringe armed with a special tip) and

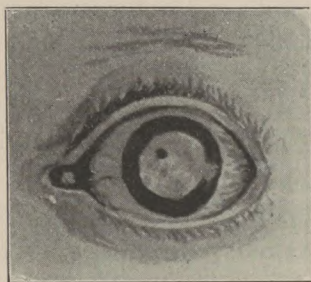


FIG. 135.
Foreign body in the lens; lens cataractous.

withdraw most of the lens substance remaining, washing the anterior chamber with a normal salt solution, using the same syringe. There is but little bleeding from the iris; the eye is closed and dressed.*

Mr. C. N., a metal-worker, aged twenty-eight, received a fragment of steel or emery into his right eye. The corneal wound is clearly marked and the particle can be plainly seen just beneath the capsule in a milky lens. The pupil must have been widely dilated at the time of injury for the iris does not seem to have been wounded. The wound must have been quite small for there has been no escape of lens matter from the capsule. (Fig. 135.) The pressure of the distended

*There was no reaction from the operation. The ophthalmoscope confirmed our diagnosis of detachment of the retina.

lens is already causing some pain and pericorneal redness. It is important that the lens be removed at once, and while the lens substance is of sufficient consistency to float out the particle without allowing it to become entangled in the iris or lost in the anterior chamber. The operation for the removal of the lens is made in the following manner: Atropine one per cent. solution has been instilled, one drop every half hour for three hours or until full dilation of the pupil has been secured. Two drops of a two per cent. solution of cocaine has been instilled every three minutes for fifteen minutes. The eye flushed with a $\frac{1}{3000}$ bichloride solution, the eyebrows, lids and lashes cleaned with soap and water and the eye again flushed with bichloride solution. The speculum introduced and the corneal incision made as for the delivery of a small lens. The iris prolapses and the lens is forced forward against the cornea as the aqueous is discharged. The prolapsed portion of the iris is excised. It is fortunate that the lens capsule did not rupture with the relief of pressure. The cystotome is introduced and the capsule ruptured opposite the foreign body. The lips of the corneal wound are held apart with the cystotome and the lens substance flows out, carrying with it the fragment of iron. The patient has been very quiet, allowing full control of the eye. The toilet of the wound is carefully made and the eye again flushed with a $\frac{1}{3000}$ bichloride solution, a compress of absorbent cotton placed and over all a starched bandage applied.*

*Loss of vitreous during the progress of an extraction of cataract is always a source of embarrassment and no little anxiety. Such cases are much more liable to infection, with sup-
puration and iritis and later to atrophy, or to cyclitis and in-
crease of tension and secondary glaucoma; though cases which
pass through the post-operative period without complication
go on to complete recovery and years of useful vision.*

* The recovery was uneventful, the excised section of the iris was so small that the pupil is nearly round.

The danger seems to arise in main from the greater liability to infection from the shreds which are held in the lips of the corneal wound especially at its angles.

This patient, Mr. O., aged seventy-two, has a well-matured cataract in both eyes. He has always had good general health, but began the use of glasses for reading at thirty-six years of age and at forty-two used his first reading glasses for distance, and quite a strong glass for near work; so that we judge that he had a high degree of hypermetropia and eye-strain during his youth, for he was subject to afternoon headaches and one eye was "cocked" when he was a child. There is an *arcus senilis* in the periphery of the cornea. It is now eight years since his vision began to fail, and five years since



FIG. 136.

a. b. Incision. c. Iridectomy.

he became blind. Both lenses are over-ripe, the pupil does not dilate freely, but we are able to make out what seems to be a calcareous degeneration in the lens capsule and in the lens substance. The lens is a deep-amber color. *The iris though immobile is slightly tremulous, a symptom of dislocation of the lens* or weakness of its suspensory ligament. In this case I cannot make out that the lens is displaced or that it falls from position when the head is held well backward or to either side. It is my opinion that the lens capsule is not ruptured but relaxed and insufficient. The tension, lens, iris and external circulation of the left eye seems to indicate that it is in better condition than the right, so I have selected it for the first operation. *The small cornea, the immobile pupil and the over-ripe lens are indications for the operation with iridectomy.* (Fig. 136.) The incision in this case will be

made in the sclero-corneal margin and the *cut-out* to the scleral side of the *arcus senilis*. A free section of the iris is made to allow the lens to pass out with a minimum of resistance and manipulation. The next step is the rupture of the capsule with the cystotome. This is done with great care lest the suspensory ligament be over-taxed and ruptured. The lens does not present and the *anterior chamber is perfectly collapsed* and the cornea so corrugated that we can make out the lens and iris with difficulty. The lids are closed, cocaine instilled and the patient allowed to rest, to allow time for the anterior chamber to fill slightly, also for the tears to moisten the cornea and the lens to free itself from its capsule, and allow extraction without manipulation. I shall allow fully five minutes. The eye is now opened and the lens found to be in the anterior chamber, its delivery is accomplished without difficulty, but following it comes a bead of vitreous. The eye is quickly flushed with a saturated solution of boric acid, the protruding vitreous excised, a toilet thoroughly made and the eye closed after the use of eserine. The iris takes its position with ease, there is but one flake of capsular matter in the field, which it is safer to leave than to attempt to remove. The loss of vitreous was due to a rupture of the posterior capsule, or suspensory ligament, owing to its degenerated condition and not to any excess of manipulation or movement on the part of the patient.*

In another case some years ago where an attempt was made to force the lens to present at the cut it tilted backward, its lower, posterior surface presenting. In that case I was obliged to deliver with a hook and there was a large quantity of vitreous lost. The eye was slow to heal and the recovery not at all satisfactory.

*The result in the last operation was good after the capsule was needled. Vision $\frac{1}{30}$ with a plus 12 d.

Complicated cataract extractions.

The first case I present to-day is one of unusual interest—one with which I have been acquainted for years.

Male, aged forty-three years. Four years ago I operated for cataract; the result, as you see, is fairly good. Our patient has been using this eye for all the work he has been doing during that time; and as his occupation demands close application and acute vision, we may say the result has been a success; but the steps which led to the result were attended by complications and embarrassments which are worthy of reviewing, as they illustrate some of the possible complications attending the operation for cataract and carry suggestions for the conduct of the operation on the second eye.

The first condition to which I will call attention is the narrow aperture and the heavy muscles of the lids, which suggests nipping of the lids, in order to, in some way, aid in the visual act. On account of the heavy muscles and the small aperture, I had an assistant use the lid retractor to hold the lids open in place of the speculum. The retractors can be more promptly removed than the speculum, and in the hand of a trained assistant they are much safer, as the patient under a strong impulse can throw the speculum out of place. If the impulse came at a critical time, you can understand the disaster which might follow. It happened in this case that just as I attempted the introduction of the cystotome, the patient nipped the lids, or attempted to, and a large quantity of vitreous was discharged. Not daring to extract the lens in the usual way, I entered the eye with a wire loop, drew the lens out, made a careful toilet of the corneal flap, closed the eye, carefully bandaging both eyes, and left the result to the repair of nature, fearing the worst, that is, that the recovery would be slow and attended by infection and resulting iritis, if not cyclitis and loss of the eye; or at best that the eye might recover and give a fair result, and later, according to

tradition, become soft and atrophic. The recovery was slow, as some capsular matter blocked the pupil and was tardily absorbed. On the sixth day the conjunctiva and integument about the eye became involved in a severe inflammation and extensive swelling with some pain. This condition we soon found was due to the use of a boric acid dressing and bathing. The erythema gradually abated by changing the dressing, using sodium chloride.

My first impression was that we had to deal with the results of atropia sulph., but subsequent observations in this case confirmed the diagnosis of Prof. Anthony, to whom I had referred the patient, he having pronounced it due to the boric acid dressing.

The result of the hurried finishing of extraction, leaving behind some capsular matter and allowing of but imperfect toilet—for we did not deem it safe to allow the eye to remain open lest the spasm would occur again and express the remaining contents of the eye—was an imperfect pupil and a secondary cataract. This we remedied to a great degree by needling the capsule, and we then obtained a good-sized aperture. The vision two months after the operation for extraction = $\frac{20}{40}$.

I have seen the patient occasionally during the past years, and have watched the development of the cataract in the right eye. The ripening has been slow, and it was not until recently that I felt justified in removing the lens. He can no longer count fingers at three feet, and can only tell that objects come between him and the light. If we had not watched the eye from the incipency of the cataract, we should take the field sensation to determine whether the retina is normal and an operation is warranted. This should be done in every case with which we are not familiar, especially those to be sent away from home for operation, for even if the diagnosis is correctly made and the lens found to be matured, should the retina prove to be diseased sufficiently to prevent useful vision, an operation would not be warranted or

advisable, unless the patient or friends have been advised of the probable result. The best test method is to hold a candle, or reflect from an ophthalmoscope a dim light over the different parts of the field and have the patients point toward the source of illumination. This patient has a good field and good perception in all parts of it. The conjunctiva is normal. It would not do to have any inflammatory or septic condition in the eye or its appendages. Inflammation in, or retention of secretions in, the lachrymal sac are among the most dangerous complications, and no careful surgeon will operate until the condition has been removed, either by treatment, or, better, by extirpation of the sac. Our patient is free from all complications of this kind.

You will remember I told you of our experience on a former occasion with spasms of the orbicularis muscle and of the uncertainty of the patient in controlling the action of the recti muscles. We have carefully prepared the patient, cleansing hair, face and eyebrows, have fully anæsthetized the eye, but before operating on the cataract I shall freely excise the lids at the external canthus and increase the aperture, relieving us of some of the dangers attending and complicating the first operation. My assistant will hold the lid with retractors, and I shall control the eye throughout the operation by holding the conjunctiva firmly with fixation forceps and grasping the conjunctiva just below the cornea. The incision is made with a modified Von Graefé knife, the cutting edge being straight from point to heel, the blade wedge-shaped, but narrow. You notice that it cuts from point to heel in entering the cornea without allowing escape of aqueous, and if the distance from cornea to nose will admit of it, the knife can complete the incision in making the withdrawal cut, simplifying the instrumentation and time consumed. You will notice that the entrance is made just at the corneal margin, but in the clear cornea nearly as low as its equator, and the counter puncture is just opposite. Our line of exit

is well within the clear cornea, the knife making its exit cut at right angles to the surface of the cornea.

The next step of the operation is the rupturing of the capsule; for we shall make a simple operation, as our patient is under control, and the iris was not injured by the knife. You notice the cystotome is very delicate and flexible. I took good care not to press upon the iris to cause pain, and was satisfied with making, as nearly as I could, a simple cross incision of the capsule. The slight movement which the patient made we were able to control with the fixation forceps, which, by the way, are without catch to hinder our letting go, should we be forced to do so by continuous spasms of the muscles, threatening to throw out the contents of the eye.

The greatest care must be used by the operator in holding the eye with these forceps *not to press or pull, just to fix the eye is the object of their use*. The extraction is completed by depressing the scleral flap of the wound and following the movement at once by slight downward pressure with the fixation forceps. The lens rises slowly from its capsule through the wound made with the cystotome, and by a gentle, steady pressure it is forced out and into the spoon. We can now lay aside the forceps, and with a delicate shell spatula coax out the flakes of cortical matter remaining, gently stroke the cornea into position, then flush the eye with warm boric acid solution. The retractors are withdrawn, the lids allowed to close and a dressing of absorbent cotton saturated with sterile water pressed nearly dry, applied, and over all a carefully adjusted, starched, mosquito-netting bandage.

The operation for extraction of a cataractous lens, under favorable conditions, is not difficult; a well-trained hand and a knowledge of the parts to be operated and their touch under forceps, knife and spatula is of the first importance. The different steps of the operation, from the cleansing of the eye to the final adjustment of the bandage, must be carefully gone over. Added to these requirements must be a complete

knowledge of all the accidents which may occur from mistake of judgment or lack of skill of assistant or of control of patient; also of the various accidents due to the hidden pathology of the eye, as fluid vitreous, degenerated choroidal and retinal blood vessels, or a weakened suspensory ligament, and there must be a ready invention, under the surrounding conditions, to apply the proper procedure to meet the emergency as it presents itself.

There are some points in connection with this case to which I shall call your attention in a special way: First, the nervousness of the patient; second, the small lid aperture and the heavy muscles; third, the habit of nipping the lids and rolling the eye about under the closed lids; fourth, the cause of cataract.

An examination, about three months ago, of the cornea of the eye which we have just operated showed that the patient had a high degree of corneal astigmatism, against the rule, and an examination of the operated eye gave so low a degree of refraction that there must have been a high degree of hypermetropia. These conditions were sufficient to account for the formation of cataract in a patient hardly old enough to suffer from senile changes arising from normal causes, and there is no evidence of the pathological conditions which are supposed to cause this change of the nutrition of the lens. Hypermetropia and astigmatism are frequently the direct cause of modified nutrition of lens and retina and not infrequently the cause of early cataract, as myopia, the result of choroidal disease, may also cause lenticular opacity.

It is common clinical experience that a *correction of errors of refraction in middle life has caused a beginning opacity of the lens to remain stationary for years*, and in some cases to slowly disappear. Improved general health following some protracted illness has also been followed by clearing of incipient cataract.

A few days ago I called your attention to a case of mature cataract of the right eye. The fellow-eye was oper-

ated upon by me about four years ago. You will recall some of the complications which attended the extraction.

Female, aged sixty-five. The patient I now present to you has a partially matured cataract in the right eye and an empty left orbit. The left eye was lost through the nervousness of the patient in the hands of one of our best operators, and the eye was enucleated by me some weeks ago. It is my purpose to-day to make a preliminary iridectomy and maturing operation upon the right lens to hasten the ripening of the lens and simplify the operation of extraction. This lens is not fully matured, for our patient can count fingers when held in good light and an oblique illumination casts rather a deep shadow of the iris into the lens substance. There is too much of the cortical substance that is yet soft and adherent to the capsule to safely attempt the extraction. There would be great danger of iritis from the pressure of the swollen fragments upon the iris and ciliary body. As our patient is left with this eye as the only hope of sight, and as she is now sightless and the chances of an early operation are not favorable—the right lens is maturing slowly—I have advised an iridectomy and a gentle massage of the lens with a very delicate foil-like spatula gently stroke the lens, taking care not to displace or rupture the capsule. This is the method of Bettman modifying the Forrester method of external massage of the lens over the collapsed cornea.

My reason for making an iridectomy is that a small corneal wound can be made and the iris excised without danger of loss of vitreous and prolapse of iris, as occurred in the former operation. The operation of extraction after a preliminary iridectomy is very simple, and the instrumentation is much less than in the simple extraction. There are objections to the preliminary iridectomy. The only one of importance is that referring to jeopardizing the eye a second time by an operation of such magnitude. But I think that in a nervous person, where there is to be a long time of blindness before the

ripening in the normal way, we are justified in doing the iridectomy and massage, as being safer and giving a patient already well advanced in life a less helpless and restricted old age.*

Mrs. O. H., aged fifty-four, had double senile cataract. The lens of the right eye was fully matured, and I advised and did a simple extraction. This is the sixth day following the operation. As I was dressing her eye this morning I directed her to look upward as I instilled the boric acid solution. With a sudden gush the wound opened and the aqueous discharged, bringing with it a *prolapse of the iris*. This patient has always been difficult to care for and the operation for extraction was embarrassed by the lack of self-control. From the first dressing, sixty hours after the operation, until this morning she has been quite intractable, every dressing being attended by an annoying blepharospasm, though there has been no reaction. Cocaine has been instilled. We shall excise the prolapsed portion of the iris and free it from its incarceration in the corneal wound. Eserine is used to contract the pupil and the eye is dressed with a pressure bandage.†

Prolapse of the iris occurs sometimes during the first sixty hours, and should it occur the patient will complain of pain. The eye should at once be opened and eserine instilled, and if the iris does not recede it should be excised. I have never had bad results following a prolapse. Should the iris prolapse

*It may be of interest to those who read these abstracts, and to those who reviewed the patients with me, to know something of the result of these cases. The first made a good recovery. Vision three months after the operation = $\frac{3}{80}$ with correcting glasses. The canthoplasty left no deformity. The left eye, the one first operated, continues good, and there has been no sign of ciliary change. The second returned about three months after the preliminary iridectomy with a fully matured cataract in the right eye; ten days after an uneventful operation and recovery, vision +10. d +3cy. 180° = $\frac{3}{80}$, field clear and eye free from irritation.

†There was no reaction following the iridectomy. Vision is $\frac{3}{80}$ with a plus 9 d.

during the course of a simple extraction and not replace itself without direct manipulation I prefer to excise a small notch in its margin when it will withdraw into the eye.

The objections to extraction without iridectomy, or simple extraction, is the danger from prolapse of the iris and the bruising of the iris in the travel of the lens. The points favorable to a simple extraction are the simple technique and a round pupil. In selected cases, i. e., a large cornea, a mobile iris and an obedient patient, I prefer the simple extraction; whereas in extraction with iridectomy, a small cornea, shallow anterior chamber, a large lens and a refractory patient.

Mr. L. A., aged forty-two years, about five months ago had typhoid fever followed by a relapse. His vision was good prior to his illness. During the past three months he has not been able to see to go about on the street, and can only count fingers when they are held against a strong light. Upon inspection the external appearances of the eyes are normal with the exception of the lens, the pupillary space being filled with a grayish-white opacity, perfectly homogeneous in color, admitting a deep iris shadow. The lens seems to be somewhat swollen and it has a watery appearance. My diagnosis of soft cataract is based upon the age of the patient, he being rather young for the senile variety, and the uniform translucency of the lens, as against the striated, mottled and irregularly opaque lens of the hard or senile cataract. The operation should be made at once. As the left eye is higher in tension we shall proceed with it first. The iris should be dilated, a narrow keratome introduced, the anterior capsule ruptured and the soft matter allowed to discharge, care being taken to remove the lens substance in the anterior chamber and particularly from the angles of the corneal wound. (Fig. 137.) Eserine is instilled just after the operation, to temporarily contract the pupil. Its effect will last about ten hours, then the atropine that was used before the operation will reassert itself and the pupil again dilate. On the third day the dressing should be

changed and the atropine again instilled; by the seventh day a protecting shade can be used and the bandage discarded. The portions of lens substance that are retained in the capsule will swell and cause increase of tension, ciliary pain and tenderness. If the patient was under twenty I should have but little anxiety; beyond that age there is danger of serious over-tension and a paracentesis may be necessary in case the lens can be removed at once.

Cortical cataracts occurring in patients over fifty years of age are usually of rheumatic or gouty origin and will have periods of rapid growth and lowering of vision.

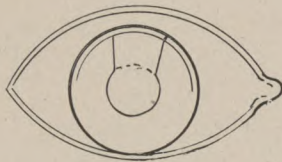


FIG. 137.

The position of the coloboma of the iris after iridectomy after the toilet is completed. Dotted line shows position of iris after extraction without iridectomy.

Both eyes are usually involved and to about the same degree. (Plate XXIII, Figs. 3-7.) Many of the cases which have come under my observation have been hypermetropic to a high degree and have had their errors corrected late in life.

Mrs. C., aged fifty-six, comes to our clinic complaining of low vision. She has had chronic articular rheumatism with enlargement of the joints of both hands and feet. During the periods of pain and swelling the vision is low and painful. The rheumatic trouble has been slowly progressive for nearly ten years. She first noticed the failure of visual acuity about four years ago. Cocaine has been instilled and the pupils are dilated. You will observe that extending from the periphery to the center of the lens are numerous spike-shaped opacities,

and that each spike is surrounded by a less opaque grayish nebula. Some of the opaque lines extend nearly to the center of the lens.

The nucleus of the lens is transparent and allows of clear vision through a limited field, as the upper segment is not obscured by either spikes or nebulæ. The pupil which is dilated by cocaine allows of clear vision. The fundus does not present any evidence of disease and she is able to see clearly $\frac{2}{4} 0$, whereas before the pupil was dilated she was only able to see $\frac{2}{8} 0$. I shall send the patient to the general medical clinic for the treatment of her rheumatic trouble and direct that she visit our clinic three times a week for massage with galvanism. The treatment is applied in the following manner: Six to ten cells of a galvanic battery are thrown into circuit, the negative pole applied over the eye and the positive pole to the nape of the neck. The electrodes are covered with absorbent cotton and moistened. The operator gently massages the eye, the current being sufficient to cause slight vertigo in making and breaking the circuit. The sitting should last fifteen minutes and be repeated every second day.

Correcting glasses should be worn as required. Fifteen to twenty treatments, under favorable conditions and with improvement in the general condition from proper treatment, should show marked betterment of vision. The objective change is to be observed in the clearing away of the nebulæ surrounding the spikes. I have cases under occasional observation in private practice, of from eight to fifteen years standing, in which vision has improved and remains good. It has required constant watchfulness and care on part of both patient and physician to secure and keep the clearness of vision obtained. Our clinics are not good places to study such cases on account of the irregular attendance of patients. In some of my cases vision has improved from $\frac{2}{18} 0$ to $\frac{2}{3} 0$ and $\frac{2}{2} 0$, which has been, with slight relapses, maintained. The massage is

an important factor and the patient can be instructed in its use.

The nuclear forms of cataract do not improve under treatment though they may at times remain stationary and even seem to clear away without special treatment or attention. The nutrition has a modifying influence.

Preliminary iridectomy, a section of the iris is being made some weeks before the lens is removed, is an ideal procedure, but in many cases it is not practicable, especially in patients living at a distance, to whom it would mean a long journey and confinement in a hospital repeated. I have frequently done the preliminary iridectomy on elderly patients who passed through the first operation and post-operative treatment without accident, yet when the second operation was under way would be uncontrollable and seriously complicate the extraction. I have with regret abandoned the preliminary iridectomy, except in patients who are very nervous and uncontrollable at the time of, or during, the first steps of extraction. In these cases I do an iridectomy, close the eye, and do the extraction about eight weeks later. The case which we have just operated illustrates the first point.

Dr. P., a physician, consulted me about fourteen months ago. I then found a senile cataract nearly matured. He desired an immediate preliminary iridectomy. As both eyes were blind and he could not see to get about, yet from his reading upon the subject he preferred the preliminary iridectomy with the attendant delay. He went through the preliminary operation without a movement and the recovery was perfectly satisfactory. There was no pain, redness or post-operative irritation. He comes for the second operation or extraction to-day with some dread, and I have advised that he delay it a day or two. He would not consent and, as you have just witnessed, we extracted the lens. From the start to the finish it was accomplished with difficulty, it being almost impossible to restrain him and prevent luxation of the lens. Even

the toilet of the wound was accomplished under difficulties. Though he felt no pain and the instrumentation was simple, two or three times there were violent spasms of the recti muscles which delayed the delivery of the lens and rendered the use of the hook necessary to secure its removal, and when it was delivered it was followed by a small quantity of vitreous.

I am confident that had we extracted the lens at the time of the first operation it would have been accomplished in a much more satisfactory manner.*

Dislocation of the lens may occur as the result of direct or indirect violence. (Fig. 138 a. b.)

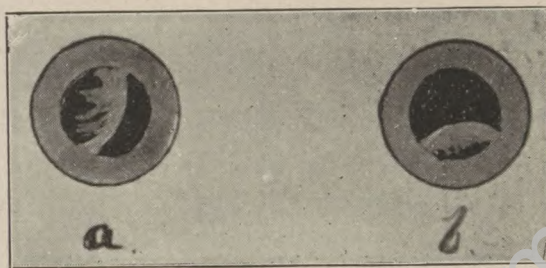


FIG. 138.

a, Lateral dislocation. b. Downward dislocation.

Master T., aged fourteen, comes to our clinic with the following history: He was having a friendly argument with one of his comrades yesterday when he received a blow directly over the left eye. It stopped him for a moment but he finished his bout. He soon noticed that the vision was low in his left eye, and consulted his family physician who referred him here. On examination we find the eye blackened, the anterior chamber is very deep and the pupil rigidly dilated. The refraction is different from the other eye, being slightly myopic. The media are transparent, but the light transmission is not perfect, and the image of the fundus is distorted. Examination with oblique illumination shows the lens to be in

*Dr. C. made a very satisfactory recovery and with a +9 s. with a +2 cy., ax. 180, he reads $\frac{20}{30}$.

the anterior chamber, for I am able to make out its margin by the play of the light upon its rounded edge. If the lens is left in this position it will soon swell, become opaque and cause severe pain by its pressure upon the iris and corneal angle, and from increase of tension. The lens can be delivered from its position by a corneal section with a narrow Graefé knife. The eye is prepared as for a cataract operation. Eserine is instilled to put the circular fibres of the iris into active contraction to support the lens. The lens is transfixed with a needle, a short corneal section is made with a Graefé knife and enlarged to allow the lens to escape. Great care must be used to prevent the prolapse of the lens into the posterior chamber for the transparent lens in the chamber of the vitreous is difficult to detect. If such an accident should occur it is safer to allow the lens to remain than feel about for it if it cannot be seen. In the adult a dislocated lens is of more serious importance, especially if it has been dislocated backwards, for as long as the lens remains transparent and the capsule is not ruptured it does not swell and causes but slight irritation. But the lens does not remain clear after *complete* luxation, and sooner or later, if left in the eye, becomes a source of irritation. If the lens cannot be removed it may cause uveitis, and enucleation or evisceration will be the only relief. Partial dislocation may occur and the lens remain clear for years.

The operation for the relief of secondary or membranous cataract is attended by no little danger from cyclitis or irido-cyclitis, and should never be undertaken when there are symptoms of irritation. A dense capsule is difficult to perforate and cut. Frequently it is necessary to introduce two needles to avoid traction on the ciliary body, or iris, if posterior synechia has taken place. The instruments used are speculum, fixation forceps and two properly made needles, Knapp's model. The preparation of the patient should be as careful as for extraction. (Fig. 139.)

Mrs. O. H., was operated in this clinic for cataract about four months ago; she returns to-day complaining that her vision, which had been quite good with correcting glasses, is failing. An examination of the pupillary space discloses that it is veiled by a thin, web-like membrane which interferes with her vision. This is the posterior capsule of the lens and it is becoming opaque by the change of its structure. The capsule could not be made out three weeks after the operation. Atropine has been used to dilate the pupil, cocaine instilled and the speculum introduced. The assistant holds the eye with fixation forceps. The needle for fixing is introduced near the



FIG. 139.
Secondary, or capsular cataract. Oblique illumination.

upper margin of the cornea and passed into the center of the capsule. The other needle is entered at the lower portion of the cornea and passed to a point just near the first needle, as indicated in the drawing. (Figs. 133 and 134.) This makes a V-shaped flap in the capsule, the apex being upward. The knives are then withdrawn and the eye dressed. Atropine may be used if there is any flushing following the operation. Perfect rest should be insisted upon until the eyes are free from asthenopia. Should iritis follow atropine should be instilled every four hours, the eyes shaded, and saline laxatives administered.

Mr. McC., aged fifty-two years, highly myopic, discovered that he could, by changing the position of his head down-

ward to the left, see well at a long distance. With his head in the normal position he can only see clearly at a distance of fifteen inches and has always held his book or paper six or seven inches from his eyes in reading. Examination shows the iris to be tremulous, and lens reflex displaced. With the head thrown backward and to the left the margin of the lens is seen to slowly descend and tilt backward; when the head resumes the erect position the lens slowly drops forward, though the nasal margin of the lens can be seen with the lens in this position. There is myopia with lens in position amounting to -13 d. I have seen this patient occasionally

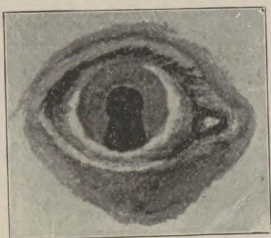


FIG. 140.
Coloboma of the iris and lens.

for seven years and there seems to be no change in the transparency of the lens or the general condition of the eye.

Ectopia lentis, or congenital displacement or malposition (Fig. 138) of the lens, is well marked in this patient.

Mary C., aged ten years, eyes small, cornea not clear at its margin, eyelids only partially opened, partial ptosis. There is absence of the iris over a small area (Fig. 140), in fact a coloboma of the iris, ciliary body and choroid extending up to the disk. (Fig. 141.) The lower margin of the lens is notched and is displaced out and upward. There is a small nuclear cataract. Vision with a $+9$ d. equals $\frac{2}{80}$ and there is some irregular astigmatism. There is nothing to do for this case except to correct the error of refraction.

The following observations occur to me in connection with cataract: Congenital cataract with a clear lens area sufficient to allow of useful vision does not require operative interference. Congenital cataract obscuring vision demands operation in early life. The anterior capsule should be needled, allowing contact with the aqueous when swelling and later absorption will take place after which the posterior capsule may need operating to allow clear vision; correcting glasses

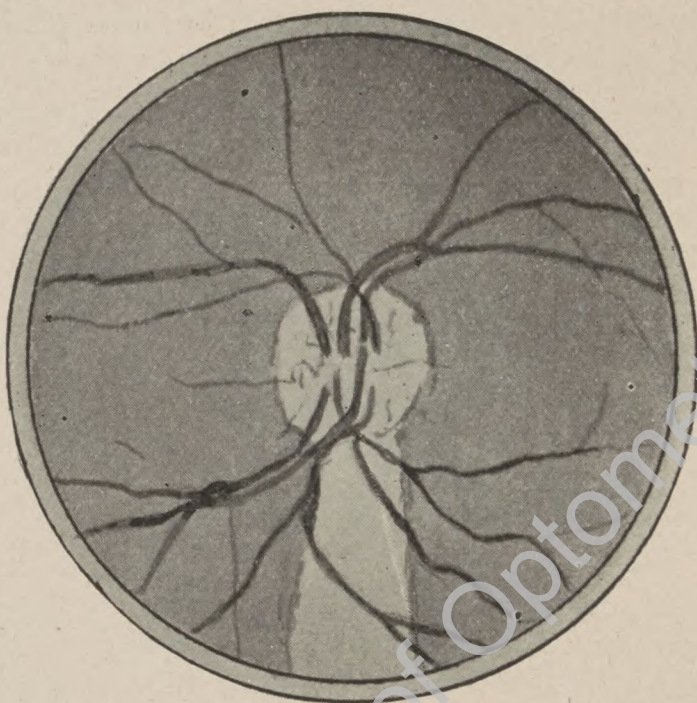


FIG. 141.
Coloboma of the choroid.

can then be given. After needling patients over twenty years of age, should the tension of the eye become too great, a narrow keratome may be introduced and the aqueous and softened lens matter allowed to escape. Iritis and iridocyclitis are liable to follow this operation.

Extraction of idiopathic or traumatic soft cataract may be accomplished by using a narrow keratome and making a peripheral corneal incision. Make a free cut in the capsule of the lens, depress the handle of the knife slightly, withdraw it and the soft lens matter will escape. There is but little danger of inflammatory reaction.

Senile cataract should be removed as soon as the lens is ripe enough to allow a free and clean delivery from its capsule. The conjunctiva and lachrymal sac should be free from catarrhal inflammation. The choice of operation should be determined by the condition of the patient, the shape and size of the lens, and the mobility of the iris. A shallow anterior chamber, with an immobile pupil necessitates an iridectomy. A deep anterior chamber, large cornea and freely moving pupil allows of choice between simple extraction and extraction with iridectomy. *Only one eye should be operated upon at a sitting and several months should be allowed to elapse between operations.* Every step of the operation, from the preparation of the patient to the final dressing, should be done by or under the supervision of the surgeon. No operation in surgery requires such perfect technique as does cataract extraction.

CHAPTER X.

ERRORS OF REFRACTION AND ACCOMMODATION.

The study and discussion of the questions pertaining to the *refraction* and *accommodation* of the eye with a class of general practitioners, and those who are doing or preparing to do special work, renders it necessary that the instruction be primary and much that is technical eliminated. To those who are advanced it will be a review of the essentials; to those studying it seriously for the first time, for to a very limited extent is it taught in the schools, it will be an introduction into a new field of work which will be of diagnostic value, even though they do not carry it to the extent of becoming expert. For a full exposition of these subjects I would refer you to Landholt, Thorington, and others.

I shall in this part of the lectures attempt to cover the ground necessary to teach a general practitioner how to diagnose a case of error of refraction, and the more advanced student how to examine and treat his cases, and in doing so I shall endeavor to avoid the discussion of the subjects which are confusing to the primary student. I shall not, however, attempt to cover the ground to the edification of the special workers.

We receive our impression upon the retina much as the impressions are carried from external objects to the sensitized plate of the photographic camera. Every point in the external world to us visible is rendered so by a cone of light projected from that point to our cornea. (Fig. 142.) The rays are then bent and formed upon the retina. Every object which we see must be made up of luminous or illumin-

ated points, and our eyes the receptacle of the innumerable cones of light (Fig. 143), which when properly focused upon the retina form (Fig. 144) a minute picture. The part of the object most clearly seen must be at the *fovea centralis*, or the point of the most acute vision. From that point in the visual field to the periphery the sensations are less and less distinct. In order to adjust the lens of the photographic camera to the different distances it must be moved nearer to, or farther from, the sensitized plates. The adjustment of the human camera is accomplished by voluntarily increasing or decreasing the power of the lens by the change of its curvature. (Fig. 145.) This adjustment is called the act of *accommodation*.

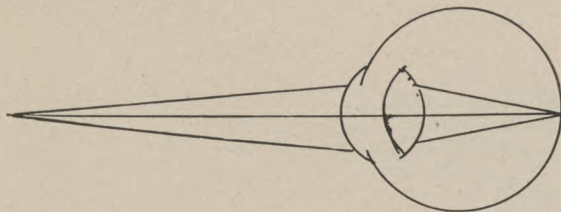


FIG. 142

The bending of the rays of light, the *refraction*, the *adjustment* of the visual field to secure binocular vision, *convergence* (Fig. 53). When a ray of light passes from a medium of a certain density to another of greater or less density its direction is not changed if the surface of the medium is at right angles to direction of the ray of light; if the surface is inclined the ray will be bent or refracted. (Fig. 146.) The refracting media of the eye are the cornea, aqueous, crystalline lens and vitreous.

A *normal, or emmetropic, eye* is so constructed that the beam of light made up of parallel rays is focused upon the retina without effort of accommodation on the part of the eye. (Fig. 147.)

An eye may be *ametropic*, or abnormal, in refraction from three causes. First, the eye may be too long, *myopic*,

(Fig. 148) or too short, *hyperopic*, for its refracting power. Second, the refracting media may be irregular in curvature i. e., one meridian may have a greater curvature than the one at right angles to it (*astigmatism*), some points focused upon the retina and others in front or behind it (Figs. 149 and 150).

Either of the above conditions may be combined in the same eye, producing *compound hyperopic astigmatism* (Fig. 151) or *compound myopic astigmatism*. (Fig. 152.) In *mixed astigmatism*, one meridian myopic and one hyperopic (Fig. 153), or the cornea may be imperfect in surface due to wounds or injuries and the *astigmatism irregular*.

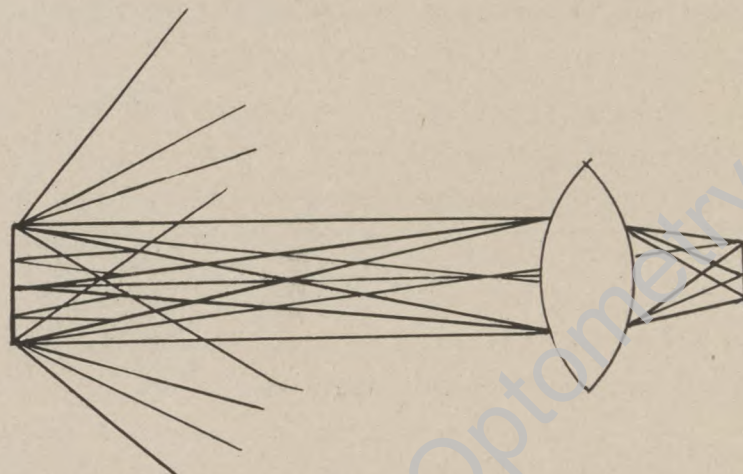


FIG. 143.

From birth to old age there is a slowly progressive change going on in the structures and functions of the eye.

As a rule the eye of the infant is too short for its refractive power, or *hyperopic*. The evolution of the normal eye is toward the point where the refraction of a beam of light is focused upon the retina without effort, *emmetropia*. This development is usually accomplished before the eighth year, though it may be delayed or hastened by disease or over-rapid development. If the infant has an abnormally short eye, or the development of the eye is arrested, it remains hypermetropic to a greater or less degree through life. If the eye develops too rapidly, or becomes diseased and the tissues are too weak for the intraocular pressure they stretch

and the eyes become too long, *myopia* resulting. The lens and cornea may also become too great in refractive power and bring the focal point anterior to the retina. Spasm or over-accommodation may increase the curvature of the lens and produce periodic or symptomatic myopia.

Heredity plays an important part in producing the anomalies of refraction; the size and shape of the eye is transmitted from one generation to another to a degree, as are other modifications in the shape of the head and face and general structural peculiarities. Environment, disease and occupation may modify these conditions. A child whose ancestors were farmers, or who were engaged in occupations not re-

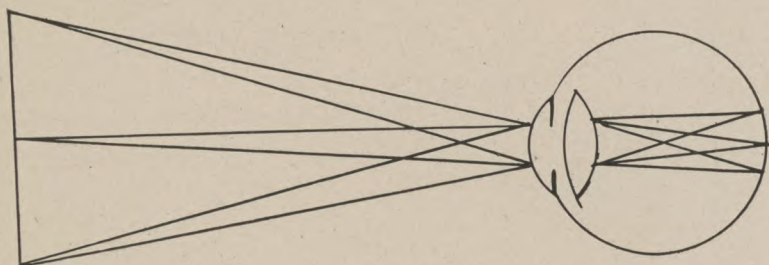


FIG. 144.

quiring the use of the eyes for close work, may inherit the tendency to have short or small eyes. The child being placed in school or at a trade requiring work at short range the eyes are over-taxed, the nutrition is impaired in the effort to correct the defect by accommodation, the choroid coat distends and acquired myopia results.

The child with normal eyes has an extensive range of accommodation; he is able to see clearly objects held very close to the eyes or at a very remote point. The closest point at which a person can see a letter of standard size is called the *proximal point*, and the most distant point at which he can see another letter of standard size is called the *remote point*; the distance from his proximal to his remote point is his range of accommodation. If he could see clearly the let-

ters at six inches that are marked for six inches, and the letters marked for twenty feet, at twenty feet, his range of accommodation would be considered normal. As age advances the range of accommodation becomes shorter, the proximal point recedes until at from forty-two to forty-five, the distance at which a person is able to read a standard type reaches twenty to twenty-five inches, and they are said to be *old-sighted*, or *presbyopic*, and with every advancing year the proximal point moves farther away.

The examination of the eyes to determine an error of refraction demands but few instruments and test cards. The rays of light coming from twenty feet are practically parallel and it requires no effort of accommodation on the part of the

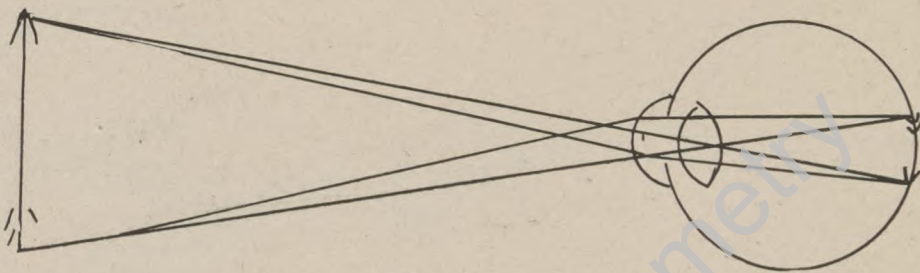


FIG. 145.

normal eye to focus them upon the retina. It has been found that a letter built upon a certain scale placed at the distance of twenty feet from the average normal eye will be clearly seen. We have a system of cards constructed upon a standard scale which are almost universally used for testing vision. They are known as the Snellen test-cards. The card for proximal or reading distance (Fig. 154) should be held at fifteen to eighteen inches away, the card for testing distance at twenty feet. (Fig. 155.) The test-case outfit will depend upon whether the physician desires to use it for the purpose of diagnosis or for correction. A trial case for the purpose of diagnosis should consist of lenses of the following strengths and kind: Six convex, or plus, lenses, $+ .50 + 1. + 3. + 5. + 7.$; six concave, or minus, lenses, $- 0.25 - 0.75. - 2. - 4. - 8. - 10.$; and a simple trial frame, each eye-piece holding two lenses, a

stenopaic slit and a Maddox rod and a red glass; also prisms 1° , 2° , 3° , 6° , 10° . By combining lenses you will be enabled to secure quite accurate results.

The routine work of examination can be best illustrated upon a patient.

Master K., aged sixteen, attended school until headache and drowsiness became unbearable and his general health suffered. His teacher suggested that his discomfort might come from defective vision. You will observe that he has rather small, deeply-set eyes, that his face is flat and his nose-bridge low, his forehead corrugated from scowling. We place him

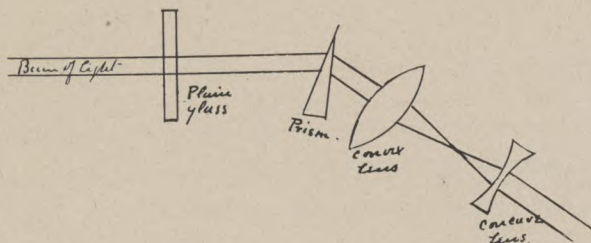


FIG. 146.

twenty feet from the test card and request him to begin with the largest letter and read as far down on the card as he can. Testing both eyes together he can read as far as the letters marked to be read at twenty feet. With the eyes tested singly he reads with the right eye the line to be read at twenty feet, and with the left line twenty feet. We will make our record in the following manner: R. V. = $\frac{20}{20}$; L. V. = $\frac{20}{20}$, using the distance at which the patient was placed from the test card as the numerator and the letters read as the denominator. To indicate normal vision we would place it in this way: R. V. = $\frac{20}{20}, \frac{6}{6}$; according to the system of measurement used—English or French.

We now hand our patient a test card for measuring his near or proximal point and find that for a short time he can read at fourteen inches the type marked .50 d., or half-meter,

but he complains of blurring vision from reading either distant or near card for a long time.

We now call his attention to the card upon the wall, both eyes being uncovered, and place a + 1. d., a glass of about forty inches focus, in the trial frame and find that his vision is blurred; we next place a -1., and find that he reads $\frac{20}{20}$ and from this determine that there is a spasm of accommodation. Atropia sulphate, one per cent. solution, is instilled once in four hours for two days. Second test made forty-eight hours later. With either eye he reads 80, or the line to be read at 24.d. or meters, the record is made $\frac{20}{80}$ or $\frac{6}{24}$. Up to this point we have been making a diagnosis of the error

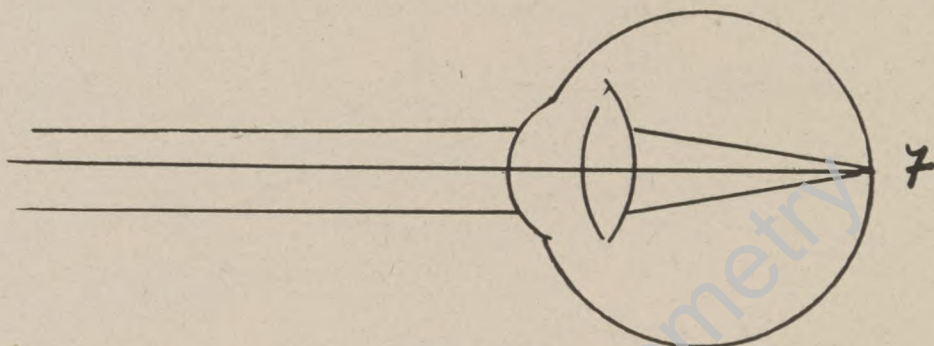


FIG. 147.

of refraction and we are able to state that our patient has an error of $\frac{20}{80}$, i. e., he is only able to read at twenty feet letters that he should be able to read at eighty feet, and has a hypermetropia $\frac{20}{80}$. To correct the error we next place lenses in front of the eyes, beginning at the lowest, until he is able to read at twenty feet the letters to be read at that distance. We find that a +2. lens in the test frame allows him to read $\frac{20}{20}$ or $\frac{6}{6}$. He has then a hyperopia of + 2. Experience has taught us that it is best to leave a part of the error uncorrected. Our prescription then will read, R. + 2.s.; L. + 2.s. Fig. 156 will illustrate this patient's refraction.

This drawing represents the normal, or emmetropic eye. We will suppose that we have a patient who reads $\frac{20}{20}$ without, and $\frac{20}{20}$ with atropia. The eye at rest then focuses the rays of light on the retina with or without atropine.

By *spasm of accommodation* is meant the unnecessary use of the ciliary muscle in too greatly refracting parallel or divergent rays of light. This spasm may exist in the normal eye and produce a condition simulating myopia, that is, by

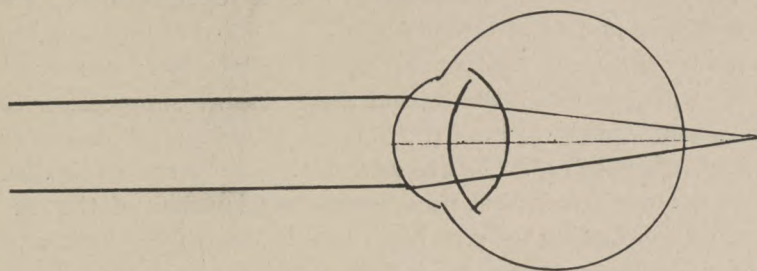


FIG. 148 (a.)

muscle effort the lens is made too great in refracting power for the length of the eye. (Fig. 147.)

An eye may simulate myopia but it cannot simulate hyperopia, for the lens cannot be reduced in curvature beyond a certain degree.

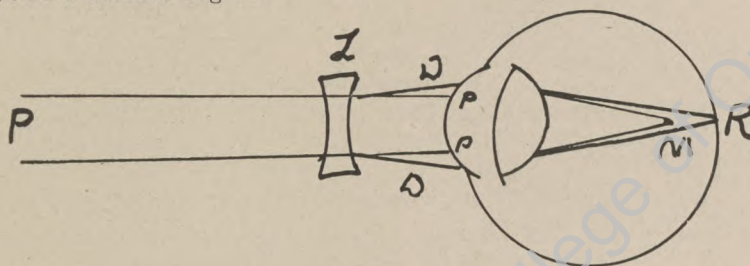


FIG. 148 (b.)

- P, pp. Parallel rays of light focused at m. in a myopic eye.
- L. Concave lens diverging lines pp. to focus at R.

Hyperopia may cause squint, either constant or periodic.

Master H., aged seventeen years, has a high degree of convergent squint. At ten years of age his eyes were apparently straight. There was first noticed a periodic convergence and later both eyes converged, resulting in constant squint the

head being posed to the right or left to adjust the error to the field. Fourteen months ago he was refracted and was advised to use his correction constantly, using the eyes independently, covering first one then its fellow with an opaque disk. He returned in two months with an improved field of fixation, and a full correction of his total error was given. He now returns to us with cosmetic balance, but there is still suppression of the second image without the red glass and an esophoria or latent squint of 15° . I have advised him to place a red disk over one eye and in that way secure consciousness of the second image, hoping to force him to overcome the diplopia and obtain binocular single vision.*

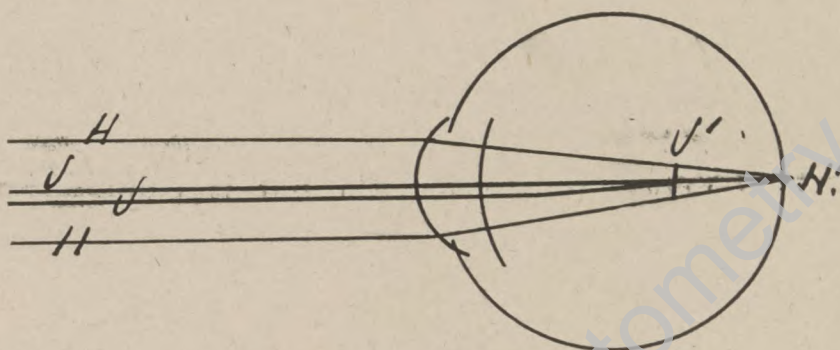


FIG. 149.

Myopic astigmatism.

H. Rays passing through horizontal meridian. V. Through vertical meridian. H'. Focus of H ray. V'. Focus of V ray.

Hyperopia may cause headache, indigestion and a lowered general nutrition with a long train of neurasthenic symptoms.

C. W., aged twenty-three years, a machinist by occupation. Has for ten years been subject to severe headaches. He was not able to continue in school and so became a machinist's helper. For two years he was in much better health but as his apprenticeship advanced he was put at closer work and his old malady returned. He now has daily headaches,

*The desired result was obtained though he has an esophoria of 15° which may require an operation for its correction should symptoms of asthenopia result.

is troubled with indigestion, constipation, intestinal intoxication and insomnia. He has been under atropine for three days, and we find that he has a total hyperopia R. + 3.d., L. + 3.50. The retinoscope gives an error of +4. d. We continue the atropine for forty-eight hours and find with both shadow and test case a hyperopia of + 4.50. d. with no astigmatism. One-half correction is given, with instructions to return for examination every month. The following history will be of interest: Four weeks later he returned and reported no headache, and accepted +3.50.d. Sixteen weeks later, improved in general health and accepted a + 4.d. Two years later, free from headaches and in perfect

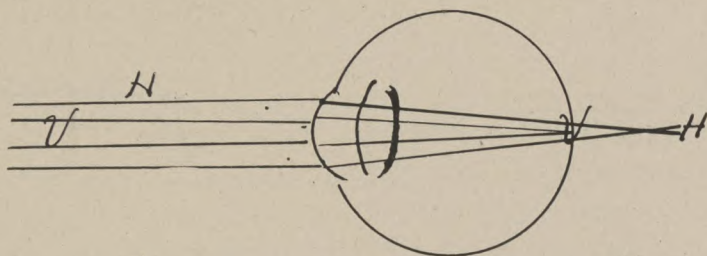


FIG. 150.

Hyperopic astigmatism.

H. H'. Meridian of error. V. V'. Normal meridian.

health. Is not troubled with constipation or indigestion and is attending night school.

Epilepsy apparently due to a refractive error.

Miss C., aged twenty-four years, has up until two years ago been subject to epileptic seizures once in from four to six weeks, and frontal headaches every day. She comes to us to-day for a general review of her case. From her ninth year she had severe headaches every afternoon; at fourteen years of age she had two attacks of epilepsy during the same week, and from then until about two years ago they recurred with increasing frequency until her twenty-second year, when she

came to our clinic for the relief of her headaches by being re-fracted. She had two seizures during the examination. Vision = $\frac{20}{20}$. Under the use of atropia for two days vision = $\frac{20}{20}$. Muscle balance normal. + 2. d. before each eye corrected the error and + 1.75 d. was given for constant use. The headaches were relieved by the first instillation of atropine. Her digestion and elimination and, as a result, her general health has been greatly improved. There has been no return of the epilepsy. I do not attempt to explain how an error of refraction may produce epilepsy, or how its correction may prevent a recurrence of the attacks. I have known other patients to

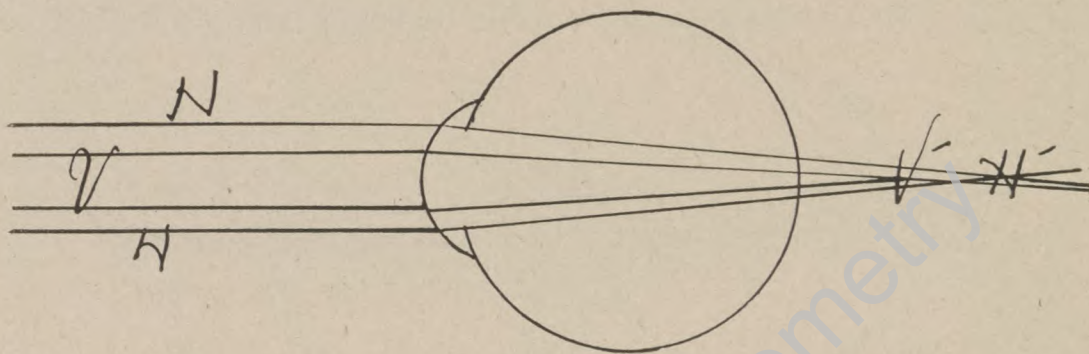


FIG. 151.

Compound hyperopic astigmatism. H. and H'. VV. are focused at a point behind the retina V' and H'.

have been cured by the removal of eye-strain irritation, also complete failure to modify the condition in other instances. In this case there was no ocular aura to suggest irritation from defective eyes. The chain of symptoms may have been formed in this way: *eye-strain*, reflex headache, reflex indigestion, disturbed elimination, toxæmia, cerebral irritation, a *predisposing cause*, and *epilepsy*.

Mr. X., aged forty-four years, consults us for *blurring of vision* and a sensation of *eye strain*. He is a carpenter and can no longer see to work up to a line. We place him at twenty feet from the test card and find that he reads the line to be read at twenty feet. A + .50 blurs his vision and we find that for distance his vision is normal. We now place the

card for the test of proximal vision before him and find that he reads Number 3 Snellen at sixteen inches. We place a +1. d. in the trial frame and he reads Number 1 Snellen when held at twelve to twenty inches, giving him a good range of proximal vision, or that the letters .50 d. are read at .50 or fourteen inches distance, and his proximal vision is $\frac{50}{50}$. His old sight or presbyopia equals + 1. This glass is only required for close work. (Fig. 155.)

<i>Presbyopia.</i>	A patient at 42 will require + .50d.
" " " 45 " "	+1.00d.
" " " 48 " "	+1.50d.
" " " 51 " "	+2.00d.
" " " 54 " "	+2.50d.
" " " 57 " "	+3.00d.
" " " 58 " "	+3.50d.
" " " 61 " "	+4.00d.
" " " 65 " "	+4.50d.

From the sixtieth to the seventieth year the change is but slight. Vision may be modified by disease affecting both the media and the accommodative power.

The first symptoms of the presbyopic period begin early in hyperopic patients.

Mrs. L. P., aged thirty-nine years, has been having blurred vision during the past year. For the past five years she has been doing more or less sewing for the little family, but this she has been obliged to give up as she could not see to work by lamp light. At twenty years of age she began having sick headaches and has been subject to weekly attacks ever since. She has also suffered from frontal headaches every morning. We test her with the wall card and find that she reads $\frac{20}{20}$ but that the letters blur and then become clear again. We now place a + 4.d. in the test frame and find that she can read only $\frac{20}{80}$. We now hold a -1. d. in front of the eye and

she reads at $\frac{20}{40}$. A + 2. d. is now held in front of the eye and our patient reads $\frac{20}{20}$. We find that this woman had a manifest vision of $\frac{20}{20}$, but by fogging her vision with a + 4d. and then slowly reducing the strength of the glass by —.50, — 1, — 1.50, — 2, we are able to secure normal, or $\frac{20}{20}$, vision + 2, giving manifest hyperopia + 2. d. As there may be more error than she now shows we will instill homatropine two per cent. solution, two drops every ten minutes four times. At the end of one hour from the use of first drops we test her vision and find that she reads $\frac{20}{180}$, and with + 3. $\frac{20}{20}$, this gives a total hyperopia of + 3. d., a manifest hyperopia of + 2., the difference between the manifest and the total gives

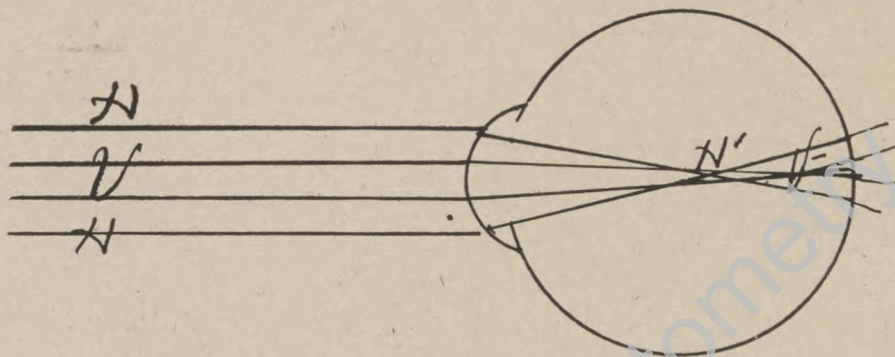


FIG. 152.
Compound myopic astigmatism.

a latent error of + 1. d. This patient, then, has been doing over-work all her life, for she has been accommodating to correct her error of refraction = + 3. d. Up to one year ago she was able to do it with only the discomfort of frequent headaches as a result, but now that her proximal point has receded so far she can no longer see clearly at fifteen inches though her remote point is normal under the accommodative effort. We shall prescribe + 2. d. spherical for constant use, correcting her manifest hyperopia, and as soon as her eyes become accustomed to the aid of this correction, which may be one, two, or three months, for *muscle habits are overcome very slowly*, we will give her a correction for her total error, or + 3. d., and with this she should be able to

use her eyes freely without further aid until she reaches forty-two or forty-three years of age.*

Hypermetropia in youth.

Master T., aged fourteen, school boy, has been brought to our clinic by his father at the suggestion of his teacher. He is unable to keep up with his class, is dull in school work, but quickly grasps oral recitations. His parents, on account

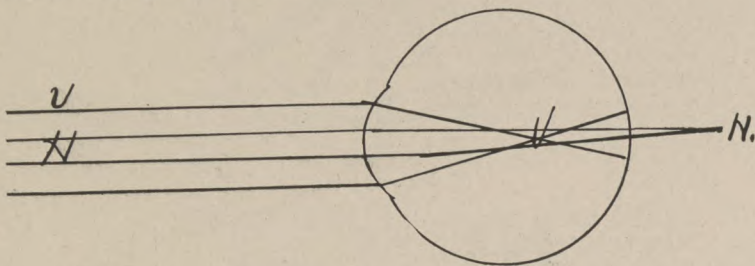


FIG. 153.
Mixed astigmatism.

of his low marks in school, have thought him to be below par mentally. He is certainly slow and dull, for it is with difficulty that we can get him to attempt to read the test type. This may be due in part to the dread of making an error. We find that he can read the $\frac{2}{8} \frac{0}{0}$ line if we first call attention to that line, but when we call attention to the letter at the top of the card and require him to read down we find his eyes become fatigued, and that he can only read to the $\frac{2}{8} \frac{0}{0}$ line. By adding a +1. d. he reads to the $\frac{2}{8} \frac{0}{0}$ giving a manifest hyperopia = $\frac{2}{8} \frac{0}{0}$. Atropine has been instilled once in four hours for forty-eight hours, and we find on examination that +5. d. enables him to read $\frac{2}{8} \frac{0}{0}$ -1 each eye repeatedly tested.

Manifest hyperopia +1.—The amount of error shown without atropia.

*This patient returned to our clinic six weeks after the first correction and we were able to give her +3., a full correction of her error, for constant use, and she reported but one headache since her first visit.

Total hyperopia +5.—The total amount of error under atropine.

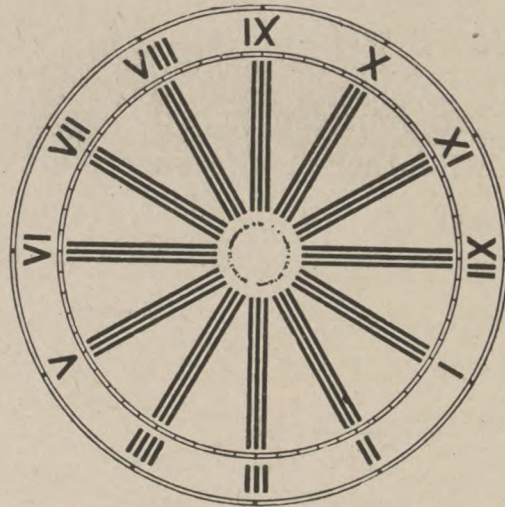


FIG. 154 (a).



FIG. 154 (b).

Latent hyperopia +4.—The error covered up by accommodation.

I shall advise the atropine be continued for one week and prescribe +4.d. for constant use.

D=1

V=.50 D.

A history in which every particular incident may be true may on the whole be false. The circumstances which have most influence on the happiness of mankind, the changes of manners and morals, the transition of communities from poverty to wealth, from knowledge to ignorance, from ferocity to humanity—these are, for the most part

noiseless revolutions. Their progress is rarely indicated by what historians are pleased to call important events. They are not achieved by armies, or enacted by senates. They are sanctioned by no treaties and recorded in no archives. They are carried on in every school, in every church, behind ten

D=2.

V=.75 D.

thousand counters, at ten thousand firesides. The upper current of society presents no certain criterion by which we can judge of the direction in which the under-current flows. We read of defeats and victories. But we know that nations may be miserable amid victories, and prosperous amid defeats. We read of the fall of wise ministers, and of the rise of prodigal favorites. But we must remember how small a proportion

D=3.

V=1. D.

the good or evil effected by a single statesman can bear to the good or evil of a great social system. Bishop Watson compares a geologist to a gnat mounted on an elephant, and laying down theories as to the whole internal structure of the vast animal, from the phenomena of the hide. The comparison is unjust to the geologists; but it is very applicable to those historians who write as if the body-politic

D=4.

V=1.25 D.

were homogeneous, who look only on the surface of affairs, and never think of the mighty and various organization which lies deep below. In the works of such writers as these, England, at the close of the Seven Years' War, is in the highest state of prosperity. At the close of the American War she is in a miserable and degraded condi-

D=5.

V=1.50 D.

tion, as if the people were not on the whole as rich, as well governed, and as well educated at the latter period as at the former. We have read books called Histories of England, under the reign of George the Second, in which the rise of Methodism is not even mentioned. A hundred years hence this breed of authors will, we hope, be extinct.

FIG. 155.

Test card for proximal vision.

The purpose of the continued use of the atropine is to relieve the spasm of accommodation over a sufficient period to break the habit and allow the use of a correcting glass.

(Note.) The patient returned to us with a very encouraging report from his teacher, to the effect that he was able to do full work and stood well in his class; and from himself that he did not have headache and could keep awake during the afternoon and evening study hours.

Every child before entering upon school work should be carefully examined as to visual power. If this is not attended to the child may enter upon his work seriously handicapped, for our public-school system is no respecter of persons. The labor against such heavy odds, as shown in this last case, may so discourage and hinder a child in his work that he will become in fact that which he is suspected of being, stupid and mentally incompetent.

Shall we use a cycloplegic in examining patients with errors of refraction? Yes. All patients under forty-two should be examined both with and without cycloplegia. In this way only can we be sure of the static refraction of the eye.

Shall we give a full correction in all cases of hyperopia? No. Each case must be a law unto itself. In very young patients we can begin with half the total error in hyperopia and gradually increase the strength of the correcting glass until a full correction is given. When the total and manifest errors agree the full correction can be given. When correcting the adult give a full correction for the manifest error and half the latent error.

Should glasses correcting hyperopia be worn constantly? I believe that they should in order to secure the best results.

Mary P., aged sixteen years, a school girl, returns to-day complaining that her glasses do not fit her as well as they did when she first obtained them a year ago. We find on her history card the following notes: "Headache, pain in the

eyes, inability to study. General health good; sick headaches once in two weeks. Atropine for three days; R., $\frac{2}{8} \frac{0}{0}$; L., $\frac{6}{10} \frac{0}{0}$; correction R. +1.d., L. +1.50. Correction given R. +.75. L. +1.37. for constant use."

Upon inquiry we find that she wore her glasses constantly for three months, but at the end of school term she discarded them. She went back to her school work without them and the headaches returned. She then tried to wear them a part of the day, but found that she could not see the blackboard. We find that she can read $\frac{2}{20} \frac{0}{0}$ without her glasses and $\frac{2}{20} \frac{0}{0}$ with them. We have a return of the spasm of accommodation and shall advise the use of one half per

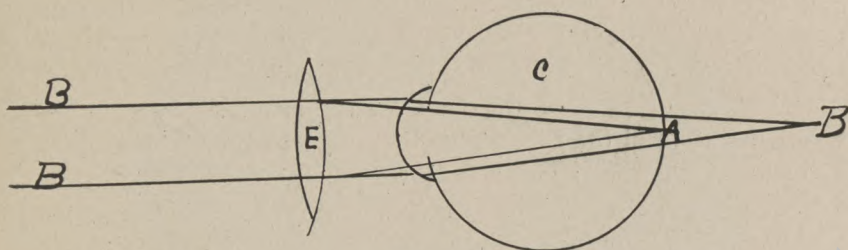


FIG. 156.

B.B. Parallel rays of light in a hyperopic eye C. focused at B'.
B.B.A. Focused at A by the aid of +2d. lens E.

cent. solution of atropine for one week and the constant use of the glasses. The use of the cycloplegic is important. In this case the disk is flushed and there is a low grade of ciliary irritation. This irritation, if continued, may develop a more serious disturbance and under favorable conditions produce inflammation and degeneration of the retina, choroid and sclera, with changes in the humors and lens and progressive myopia result.

Master L., aged ten years, came to this clinic about four years ago; vision at that time = $\frac{2}{4} \frac{0}{0}$, and under atropine = $\frac{2}{20} \frac{0}{0}$. He was not in good general health, being pale, light in weight for his years and over-fond of books, with a decided

distaste for out-of-door pursuits. His parents were proud of his proficiency in school. With a $+2.50$ sphere he had $\frac{2}{4} 0$ vision. The ophthalmoscope showed the retina to be granular or stippled over a large area about the macula, and there was a beginning posterior staphyloma. I advised the use of $+2$. ground in number three tint London smoke lenses and that he be taken out of school. The glasses were secured, but he did not leave school. Nearly two years later he returned to the clinic saying that he had only worn the glasses until the summer vacation, then put them aside until he returned to school in the fall. They did not fit him when he attempted their use later in the year, and he had some of our department store experts fit him with glasses. These he has used most of the time for about four months. (The glasses he brings are -1 . d.) He was obliged to leave school on account of pain in the back of the head and neck and inflammation of the eyes. The lid margins were clubbed and covered with crusts; vision = $\frac{2}{8} 0$ without glasses, and $\frac{2}{3} 0$ with the glasses obtained from the store. His eyes were changed in appearance, being more prominent than they were before. Ophthalmoscopic examination—vitreous cloudy and full of floating, dust-like particles, the entire fundus is changed in appearance, a posterior staphyloma well-marked, and an area about the size of two disks to the temporal side is in a progressive state of choroiditis. Under atropine forty-eight hours he had $\frac{2}{8} 0$ vision and required $+1$. to secure $\frac{2}{3} 0$. My advice at this time was that all close work with his eyes be stopped, and that he wear dark glasses and use atropine every eight hours.

He should also take tonics, cod liver oil, and, if possible, be sent to the country for a year.

At the time of this visit, four years later, we find his eyes greatly changed, the globe is much larger than is normal and the sclera is flushed and there is a decided pop-eyed appearance. The drawing (Fig. 157) shows in a diagrammatic way the appearance of the fundus; it would be impossible to give

all of the interesting details in a picture of this case. Vision $s \frac{2}{0} \frac{0}{0}$ and — 2. is required to secure $\frac{2}{6} \frac{0}{0}$ vision, the best we are able to obtain.

We have in this instance a progressive myopia the result of choroiditis caused by eye-strain, and a hyperopic eye passing over into myopia as the result of the choroiditis. Had the parents been willing to allow the child to fall behind his class in school and been faithful to our suggestions regard-



FIG. 157.

ing the use of glasses, this condition might not have resulted. There was in this case no hereditary tendency to develop myopia. The prognosis is unfavorable, and the probabilities are that the choroiditis will continue to be progressive and that by the twentieth year there will be a myopia of high degree with greatly lowered vision. The dangers are detachment of the retina, dislocation of the lens, glaucoma and cataract. Cases of this kind are not infrequent, and too great stress cannot be

put upon the dangers arising from the correction of errors of refraction by the so-called, or self-styled, "doctors" of refraction. The — 1. given by the department store *expert* only added to the danger and damage done, for the patient was obliged to use muscle power equal to — 1 d. to overcome the added error.

Myopia, or near-sight, may be due to a normal evolution of the eye, its development in the antero-posterior diameter not being arrested at the emmetropic point, or it may be the result of a progressive disease of the tunics of the eye. Heredity plays an important, though not the only, part in producing axial myopia. Measles, scarlatina, diphtheria and other septic and infectious diseases seem to favor the development of choroidal disease, and if the eyes are not carefully guarded progressive or progressive pernicious myopia may result. The facial conformation of the hereditarily myopic person is always suggestive; a long, narrow face, high, sharp nose-bridge, prominent supraorbital ridge and narrow between the temples. In acquired myopia the picture is apt to be reversed, for they are recruited from the ranks of the hyperopic and it usually does not begin to manifest itself until after ten years of age.

To examine a case of myopia have the patient stand at twenty feet from the test card. If he cannot read the top $\frac{20}{200}$ letter at that distance have him slowly approach the card until it becomes visible; your record would then be $\frac{8}{200}$, or $\frac{10}{200}$, as the case might be. He can now return to the chair and the trial glasses used to measure in diopters the amount of error manifested. Atropine or homatropine is now instilled and the total error found, which might agree with the manifest or be even less. The difference between total and manifest being due to spasm or over-action of the ciliary muscles.

Miss K., aged twenty-four, a sewing woman, has been using glasses for about seven months. She selected at a counter the glasses with which she could see best. She says that

she can see much better than she formerly could without them, but they give her a headache and that her eyes become blurred and that she 'has specks floating before her eyes.' She reads $\frac{2}{8} \frac{0}{0}$ without, and $\frac{2}{2} \frac{0}{0}$ with the glasses which are — 1. d. Homatropine is instilled, two drops of a two per cent. solution, every ten minutes and we find that the patient at the end of forty-five minutes is able to read $\frac{2}{2} \frac{0}{0}$ without the aid of glasses. The ophthalmoscope presents the picture of acute neuro-retinitis and choroiditis, no doubt due to overwork, anæmia and spasm of accommodation. I shall advise atropine, rest, tonics and dark glasses.

This patient is in the early stages of acquired late myopia the result of choroiditis. I shall advise her to seek employment which does not demand so much from her eyes. General housework is less exacting, though the hours of labor are frequently longer. I give this case as one of acquired myopia because there is evidence that the eyes were hyperopic up to a recent date, for there is a posterior staphyloma with congested, fringed or ragged edges and the disk has a broad, so-called physiological, excavation. The choroidal changes are recent and progressive. If the disease continues in the present active state it will result not only in a myopia but, owing to interference with nutrition and drainage, iritis, secondary glaucoma, detachment of the retina or cataract may result.

Mary L., aged fifteen years, is referred to us by her teacher. About two years ago she was changed to a front seat in the school room on account of her inability to see the blackboard. She is now obliged to approach within eight feet of the board to read the work. I find that she has $\frac{1}{2} \frac{2}{0} \frac{0}{0}$ vision and that with a —3.50 d. over each eye vision is $\frac{2}{3} \frac{0}{0}$. The ophthalmoscope shows a posterior staphyloma. (Fig. 158.) Her family history shows a tendency to myopia, her mother and one elder sister have high degrees of myopia and they all have the myopic face. There seems to be no active choroiditis and but a low degree of spasm of accommodation. I shall advise

the use of correcting lenses, out-of-door life and that she be freed from close work. If these suggestions are carried out there is hope that the myopia may not become higher or the choroid become diseased. In the long eye there is but little use made of the ciliary muscle if the error is four diopters or more. The patient sees clearly only to the distance of the remote point which may vary anywhere from one to twelve feet according to the degree of error. In myopia of high degree the



FIG. 158.
Posterior Staphyloma.

near and far point may be the same. Patients who are myopic have an exceedingly limited field of observation; for that reason children who are myopic and not corrected are seldom fond of out-of-door athletics. Because of their limitations they become narrow in their activities and are apt to be precocious students. Their general health becomes impaired from enforced confinement and they become limited mentally and physically. It is important that suitable glasses be fitted at an early age, that they be worn constantly, that the amount of work in school

be well within their physical ability and that the general health be carefully guarded.

Myopia may be physiological or pathological. The near-sighted eye, as this term suggests, is so adjusted that when the eye is at rest it focuses divergent rays of light. Its punctum remotum is somewhere between the eye and the standard distance, twenty feet. Low degrees of myopia are of but little inconvenience. High myopia, however, is a serious condition both as regards the sphere of action and the health of the patient. In order to appreciate the annoyance of an uncorrected myopia place a pair of + 3. d. lenses in a trial frame and attempt to go about, read or write. Hyperopia can for a time be overcome by accommodation, but a myope is held without respite in his narrow range of vision. A child who had a high degree of physiological myopia was corrected, and going out of doors for the first time exclaimed. "I can see the house across the street, and the leaves on the trees all hang on strings." The uncorrected myope lives in a world bounded by his limited range of vision; every thing beyond is hazy and phantom-like.

Myopia is said to be physiological when there is no history or evidence of disease. The relations between the length of the eye and the refraction being one of too great refracting power, the focal point of the eye at rest being in front of the retina.

Myopia is pathological when the length of the eye has been increased by disease of its tunics.

Chronic choroiditis may produce distension of the sclerotic coat and increase the antero-posterior diameter of the eye, by forming a regular or irregular staphyloma. (Fig. 158.)

Mary B. has been myopic from her ninth year. Placed at twenty feet from the test card she reads $\frac{20}{40}$ with difficulty; — 1.50. d. gives $\frac{20}{20}$ vision. Homatropine is used, two drops of a two per cent. solution every ten minutes for two hours;

with -1 .d. she has $\frac{2}{0}$. She has then a simple myopia of -1 .d. The examination of the fundus with the ophthalmoscope reveals a normal retina and media. I shall advise -1 .d. for constant wear and that care be taken in securing a *good position in reading and writing*. She should be reviewed every year to see that she is not developing choroidal disease. We could have prescribed the -1.50 .d., correcting the manifest error, *but with no certainty that we were not dealing with a spasm of accommodation*.

Physiological myopia causes but little discomfort beyond the inconvenience of not seeing objects clearly beyond their remote point. The great danger from myopia in childhood comes from the tendency to use their full accommodation and read, write and do other close work too near the eyes. The proximal point in myopia is relatively nearer than in emmetropia. A child with a -2 .d. of uncorrected myopia will hold the book from six to eight inches from the eyes in reading, and in so doing use a high degree of convergence and in that way favor the formation of a staphyloma. *The early use of a full correction will prevent the over-accommodation and consequent convergence.*

Myopia of high degree in a youth.

Master L., aged eighteen, had measles at ten years of age, and for two years following had inflamed eyes and was kept much of the time in a darkened room. At twelve years of age he returned to school, and was seated well in front that he might be able to see all the board work; later he was obliged to go quite near the board, and could only see to read by holding his book four or five inches from the eyes. He soon outranked children of his age in school. At fifteen years he was told that his left eye was divergent. He then attempted to obtain employment, but could not see well enough to do the work offered him, and no one suggested that glasses would be of use. Just here is where his teacher should have

been better informed, for advice could have prevented the serious results of the injudicious use of his eyes. On account of his proficiency as an engraver, and his taste for that occupation, he attempted to become a lithographer, and has worked two years at that trade. About two weeks ago, while engaged at his labor, he was seized with severe pain in his working eye. He ceased occupation for a day and then re-

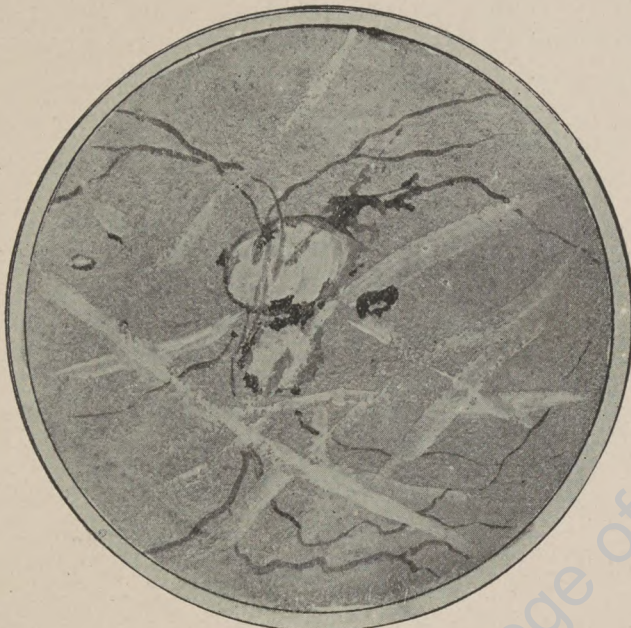


FIG. 159.

High myopia with vitreous bands, detached retina and posterior staphyloma.

turned, but found that he could not see clearly. Gradually his vision became so poor that the right eye, which had been out of use for three years, was called upon to aid him. He then came to our clinic for treatment. Remote point, R. $\frac{2}{200}$, L. $\frac{2}{200}$. Eyes very prominent and imperfectly covered by the lids. Cornea relatively small, sclerotic thin. Left eye usually used for fixing. Right eye divergent and almost immovable. — 16. d. gives $\frac{10}{200}$; L. E.—18. d. gives $\frac{10}{200}$.

Ophthalmoscopic examination: Left eye, complete detachment of the lower third of the retina, vitreous fluid, and vitreous bands are clearly made out. There was choroidal atrophy and extensive posterior staphyloma. Right eye, extensive choroidal changes, vitreous fluid and filled with areas of plastic festoons; posterior staphyloma irregular and nodulated. (Fig. 159.) The lens partially dislocated, iris tremulous. The condition is almost hopeless. The left eye has contracting fibrous bands, which are causing detachment of the retina, for which there is absolutely no relief. I shall, however, attempt to fill the posterior chamber with a normal salt solution, injecting about

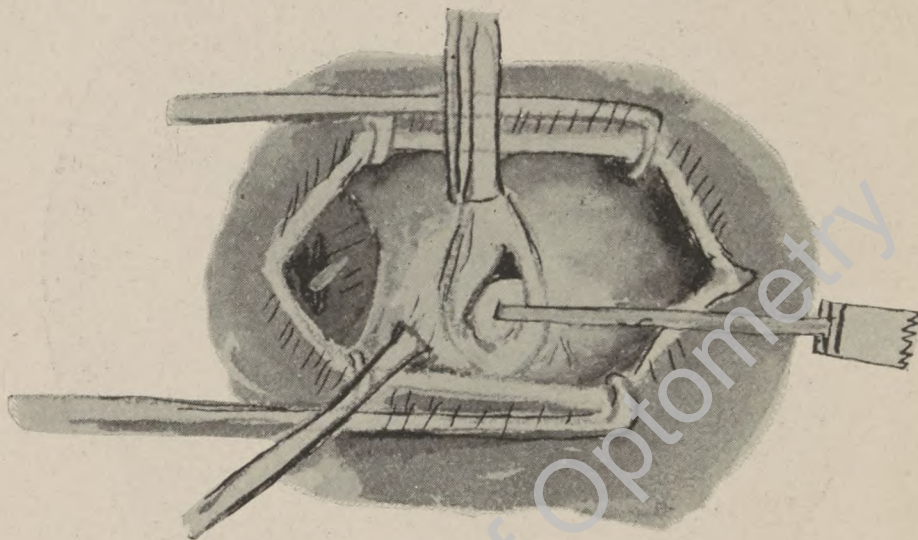


FIG. 160.

Operation for severing connective tissue bands in vitreous for the relief of detachment of retina.

fifteen minims. The right eye is in almost as serious a condition; the lens can be couched, and there may be some improvement in the vision. Correcting glasses will be of little use, as the vision is so low.

Operation:

An opening is made in the conjunctiva just below the internal rectus muscle and a very narrow Græfe knife is plunged into the vitreous (Fig. 160), cutting through the network of connective tissue. There is small loss of vitreous. Fifteen minims of normal salt solution are injected and the

scleral wound closed with a suture.* Myopia is frequently progressive, not reaching its height until the eighteenth or twentieth year.

Miss Julia L. has been under observation for about ten years. At the time of her first visit her error was $-1.d.$ She was then six years of age and had been in good health up to that time. At six years there was nothing abnormal in the appearance of the retina and no spasm of the accommodation. The father is highly myopic, without fundus changes. Two younger children, a brother and sister at two and four years of age, are still slightly hyperopic, and her mother has compound hyperopic astigmatism. This patient was observed to be near-sighted during the year previous to her first examination. I advised the use of slightly tinted London smoke glasses with her correction, $-1.d.$, and the freedom of the country. My advice was followed, and at eight years of age she came again to the clinic, and I found, under full atropine cycloplegia $-1.75 d.$ error in each eye. She has been in the first grade of school for about six months. There was still no change in the fundus, and from that time until the present visit I have seen her every two years at the end of her school term, finding that she had a change of about $.50d.$ for every two years until last year, when the increase was but $.13d.$ She has had continued good health, and has been able to do full work in the high school attended. There is a slight posterior staphyloma, which was first observed about four years ago, and I cannot make out any increase. The younger children are now myopic, the youngest $-1.d.$ and the eldest $.50d.$, without change in the appearance of the fundus from the normal. They are in good

*The left eye improved in vision, and the detached portion became re-adherent. Two months later there was a sudden and complete detachment. The right eye cannot be forced into place—it is too long to be held erect in the orbital cavity. There seems to be no change in the fundus or position of the lens.

health. The father has an error of -8 .d. in one eye and -7.50 d. in the other. He has a long, narrow face, is above the average in height, has always been employed at close work, and has worn glasses from his eighteenth year. The children resemble the father in physical development. Our patient now has at her sixteenth year about -7 .d. of error, with but $-.50$ d. increase during the past two years.

The management of a case of myopia which has reached twenty-eight years without using glasses.

Michael T., aged twenty-eight, has been employed as a bookkeeper and office man until a month ago, when he lost his position and found himself handicapped by imperfect vision in his attempts to secure a new place. He has always done his work at about twelve inches distance; his remote point is seven feet and proximal point four inches. A -3 .d. lens gives him $\frac{2}{2} \frac{0}{0}$ vision. He has been obliged to use only one-fourth the normal accommodation. His ciliary muscle is defective in power, and he finds it difficult to overcome the -3 .d. required to bring his eyes to the normal, and is inclined to lay aside his glasses for close work. This he finds an inconvenience and returns to us for advice.

Owing to the myopia the near work point which has been kept from fourteen to eighteen inches, according to the requirements of his work, he has left unused a large part of his range of accommodation, and he finds that for near work he is unable to bring it into use for a sufficient time to allow service. If he continues to use his correction only for his remote point the accommodation will not be further developed. If, however, we have added to his distance correction a $+1$.d., scale he will be able to do his work with comfort and in time develop his accommodation to the normal amount, when the plus glass can be removed.

Muscular asthenopia is an important factor in the correction of myopia of high degree—i. e., six diopters and more.

Each case must be a law unto itself, and the individual indications relieved. In myopia of six diopters and more there is no need for, and usually there is no, accommodation. In order to maintain binocular single vision the patient is obliged to employ a high degree of convergence on account of the nearness of the proximal point. This results in the disassociation of the normal relation between the two acts, i. e., +1.d. of accommodation and 1 metre angle of convergence. The act of convergence is still further embarrassed by the greater length and size of the globe, rendering the act of convergence difficult, and in high degrees of myopia impossible, divergence and monocular vision alone being comfortable and possible. One important reason for the early correction of myopia and the use of properly constructed glasses is to prevent this unfortunate sequel.

Mary Van D., aged eighteen years, comes to us for the correction of her myopia. On a previous clinic day we found that she manifested —10.50d. of myopia. She habitually read at six inches, and frequently closed one eye in the latter part of her school-day work. Every attempt to use glasses caused so much asthenopia that they have been laid aside. The eyes are extremely large and set in rather shallow, wide-set orbits, the pupillary distance being $2\frac{5}{8}$ inches. The ophthalmoscope shows the staphyloma to be very deep and irregular. There are no choroidal patches and no evidence of progressive pernicious myopia. This card will give the findings of our examination. We ascertain then that she has a vision of $\frac{20}{40}$ in right eye, and $\frac{20}{60}$ in left eye, with a —9.d. over each eye; a power of convergence of 10 degrees and of divergence 20 degrees. With the red glass in front of the left eye there is divergence of 15 degrees. Without correction she has an exotropia of 20 degrees; she can for a short time maintain voluntary single vision. My treatment for this case will be —9.d. over each eye, the lenses to be decentered out 10 mm. and a reading scale of +3.d. added for temporary use.

These glasses are for constant use. The reading scale can be increased or diminished in strength as our patient seems to demand. In addition to the glasses we must impress upon our patient the importance of holding her near work from fourteen to eighteen inches distant, and not to read, write, or sew until her eyes become accustomed to the correction. Also to use, fifteen minutes daily, the adducting prism exercise. For this purpose I prefer the Savage exercising prisms and frame. Her glasses should be reviewed every two or three months until comfortable vision is secured, making such changes as seem best. Under this treatment we hope not only to secure comfortable use of the eyes, but improvement in the visual acuity and an arrest of the progress of the myopia.

Attention must always be given to securing the best general health, correcting errors in diet, exercise, and habits of work. It is important that the glasses worn should be accurately adjusted. Physiological myopia of low degree, —2.d. and less, is an inconvenience which may be corrected by the use of glasses for distance, but careful attention should be given to the position assumed at school work, and that the desk be adjusted to the requirements of the child, not the child to the desk. The proximal point should not be nearer than thirteen inches. The stooping position should be avoided with watchful care, for the stooping shoulders and dependent head favors the development of a contracted chest, with its bad results, as well as impaired circulation in the eyes, which favors an increase of myopia. I believe that it is better to give the weakest glass which will allow of normal vision than to take the responsibility of advising that glasses be dispensed with, trusting to the care of the parents, and the already over-taxed teacher, to see that an habitual mal-position be not assumed.

In myopia always give the *weakest minus or concave lens*, which, under complete mydriasis, will give the best vision. Correct by prism exercise, decentered lenses or operations all

correctable heterophorias and instruct your patient as to the correct position to assume during work or study.

In myopia and hypermetropia the refracting media are regular in curvature and a cone of light can be perfectly focused upon the retina. In astigmatism a cone of light emanating from an illuminated point cannot be focused upon the retina. When a person with normal vision looks at a star or distant light it is seen as a regular point of light. Perhaps if the eyes are moist with tears there will be rays (Fig. 161) extending equally in all directions. *An astigmatic eye sees a star with unequal length rays extending in certain directions, or kite-like forms (Fig. 162).*



FIG. 161.

Astigmatism is caused by unequal curvature of the cornea or lens, or both, in one of their principal meridians. The cornea may be in error in one meridian and the lens in another and one counteract the other in whole or in part; or it may be mixed myopic in one meridian and hypermetropic in another. The cornea or lens may be of irregular surface, and their refracting power imperfect due to corneal diseases or beginning cataract and an *irregular astigmatism* result.

We will take these lenses into the dark-room, a +10. d. sph. and a -10. d. sph. and a +10d. cy. and a -10d. cy. The plus and minus sphericals are curved equally in all directions or meridians and are sections of a sphere. The plus or minus cylinders are curved in all but one meridian and they are sections of a cylinder. We hold the +10. spherical at its focal

distance from the light and find that the light is brought to a point (Fig. 164 a.) The -10 . spherical is held in position and we find that the light is disbursed in a circular form and that the lens casts a shadow in the center (b). The $+10$ cylinder is now held in position and the light is focused in a line. (164 c.) The -10 . cylinder is now tried and the light is separated (c) a dark area appearing between the two areas



FIG. 162.

- a. A star or distant point of light seen by an astigmatic: Vertical meridian in error. b. Horizontal meridian in error. c. Oblique meridian in error. d. Mixed astigmatism. e. Hyperopic meridian highly astigmatic. f. Compound myopic astigmatism.

of illumination. These tests will enable you to understand the action of the plus and minus spherical and cylindrical lenses upon a cone of light. We will now combine a spherical and cylindrical lens and observe the result; instead of a line of light or a point of light we have a light spot taking the form of an ellipse and in no position can it be brought to a focal point or line (Fig. 164, a and e). This is the condition of refraction in astigmatism and will explain the discom-

fort and futility of every effort of astigmatic persons to obtain a clear-cut picture of any object at which they direct their gaze, for they cannot in any position or at any distance obtain a clear image.

When an astigmatic patient looks at a test card of letters they all have the appearance of being dimmed or fringed at the edges—lines running in some one direction more than in others. When he looks at a card with radiating lines and spaces, one set of lines seem to be bright and clear, while the

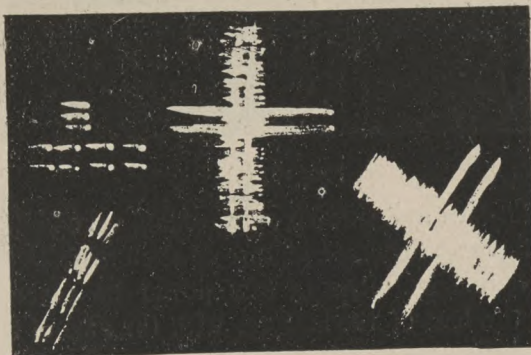


FIG. 163.

In this figure we have attempted to show why in horizontal error the horizontal line is clearly cut and the vertical line blurred. Every focal spot is an ellipse parallel with the horizontal line and crossing the vertical, hence the schematic illustration.

others are blurred and indistinct. With the accommodation suspended in simple astigmatism, *the distinct line is always at the same angle as the meridian of error.* When the eye accommodates it can make one line after another come out clearly, the former clear line becoming blurred as the accommodative effort is employed to focus a given line. When the accommodation is suspended by a cycloplegic one line alone is plain. We may, by the diagram, illustrate the error which takes place in a refracting system in which one meridian is less than the meridian at right angles to it. The effect of an astigmatic lens upon a cone of light is to focus the light pass-

ing through one principal meridian, V and H, upon the screen S at F, and the (Plate XXX) meridian M H at a point behind the screen S at K. We have demonstrated in the dark room that the result of such an experiment is a horizontal line of light. If now we have a cross photographed on a slide



FIG. 164 (a).

placed in a lantern and thrown on a screen, we will, if the lens be perfect, have an accurate picture of the cross; if, however, a concave cylindrical lens of low power be placed in the holder with the lens of the lantern, with the axis of the cylin-



FIG. 164 (b).

der at 90° , we will have an imperfect picture upon the screen, the horizontal lines will be distinct and plainly outlined, and a trifle longer than before, the vertical lines completely merged into each other, and broader and not so well defined.

The reason for this will be found in Fig. 163; no point emitting a cone of light is focused in a spot. Now, in the illustration we used the lines are horizontal. We will apply this to the Fig. 163, as shown upon the screen after the cylinder has been added. This may better be shown by a schematic drawing. We have lines V and H in the one illustration, the line formed by a focusing ray of an astigmatic lens was horizontal, the cross then would be made of numerous horizontal dashes of light, and, being parallel with the line, would slightly lengthen and not broaden it. The vertical line, however, would be made of dashes of light at right angles to the direction of the line, it would be made broader, and, the two lines being close together, would be blurred. The clear line then would be the line corresponding to the meridian of error, and the vertical line, which is blurred, would be in the normal meridian.

In correcting astigmatism the axis of the cylinder is always placed at right angles to the clear line seen on the test card for astigmatism.

In addition to the illustration just given it would be well to look at this modification of Landolt's diagram for illustrating astigmatism. (Plate XXX.)

Astigmatism is simple where one principal meridian focuses the rays of light upon the retina. (Figs. 150, 159.) The error may be myopic or hypermetropic. (Fig. 149.) In compound astigmatism both the principal meridians are out of focus. (Figs. 151, 152.)

The error may be myopic, both the meridians focusing in front of the retina (Fig. 152), or hyperopic, both the principal meridians focusing back of the retina (Fig. 151). Mixed astigmatism is where one meridian focuses in front and the other behind the retina, one myopic and the other hypermetropic (Fig. 152).

Crude tests for astigmatism: First, the star, or distant light test, trying one eye at a time. Second, make a large pin-hole in a card-board six inches square and hold it in front

of a light. In this way you can judge not only of the form of error but the direction of both of the principal meridians.

Examination with the test cards: For general work I prefer the clock dial, with the groups of the radiating lines. This card is placed at twenty feet (or six metres) distance in a good, but not too strong, light.

Master L., aged fourteen years. He was examined on our last clinic day and found to have $\frac{2}{6} \frac{0}{0}$ vision without the mydriatic. The III to IX line on the clock face was clear, and the XII to VI line blurred. By nipping his lids he could read $\frac{2}{3} \frac{0}{0}$ and make out one line after another. A +1.d. sph. brings out the XII and VI line and blurs the IX to III. We know that we have an astigmatism of about one diopter, axis 90 degrees, but we must be sure of the error, both its amount and the degree. Atropine has been instilled and complete cycloplegia secured. We find that he reads $\frac{2}{7} \frac{0}{0}$ and that the IX to III line is sharply cut and distinct, while the XII to VI is blurred, and the three lines forming the group fused into one blurred grayish line. We now take our patient into the dark room to examine the fundus for retinal disease and to determine the error with the ophthalmoscope and the retinoscope. The ophthalmoscope shows the fundus to be normal, the disk longer in its vertical than in its horizontal diameter. The vertical blood vessels on the disk are clearly outlined, but those running horizontal blurred and indistinct. A +1.25d. sph. is turned on in the ophthalmoscope, and the vertical meridian becomes blurred and the horizontal becomes clear. We now know about the amount of error in diopters. The examination by the retinoscope test is now brought into use, and a +1.d. sph. lens is placed before the patient's eyes. We find that the shadow in the horizontal meridian is still with the movement of the mirror and in the vertical meridian strongly against it. We now place a +1.25d. in the frame and find that the shadow moves just a flash against the mirror at 180°.

We know now whether the patient is amblyopic or not, that the error is about $+1.25d.$ cy. ax. 90° . We take the patient to the test card and place a $+1.25d.$ cy. ax. 90° and find that he reads $\frac{2}{20}$, and that the wheel on the clock dial is clear in all its radiating lines.*

How am I, a general practitioner, going to be able, with the few lenses suggested in a former lecture, to test a case for astigmatism and secure an approximate correction? The lenses suggested were intended for diagnostic purposes, and not for correcting and prescribing.

The use of the test card (Fig. 154) alone, with atropine instilled three times an hour, will enable you to determine the presence of astigmatism, and the plus and minus spherical lenses in the case will enable you to approximate the degree and axis of the error.†

We will now take this case to illustrate the procedure:

Our patient at once tells us that the XII and III is blurred, we place a $+1.50$ sph. in front of the eye and the VIII and II comes out and the remainder of the card, while clearer, is somewhat blurred. We now place $+1$ sph. and find that the XII and VI is clear and the remainder of the chart is blurred; we know then that the error is $1.d.$ cy., ax. 90° . In this case we shall give the full correction to be worn all the time. It is important that the correction for astigmatism be constantly worn to secure the best results, and that the glasses be first adjusted while the patient is under the mydriatic.‡

Occipital headache is always symptomatic of astigma-

* For a full and well arranged study of the use of the shadow test I would refer you to Thorington's book on the subject.

† You will frequently be obliged to educate your patient to see, as well as to tell you what they see and how it appears to them.

‡ This patient returned one year later and reported perfect relief from all of her former symptoms, with a gain in weight and improved general health.

tism. Low degrees of astigmatism, $+.50d.$ and less, are frequently the cause of the most obstinate and troublesome disturbances. The error may be so slight that visual acuity is not below the average normal standard. It is the nervous strain resulting from the effort to secure normal vision that lowers resistance, disturbs circulation, and produces the various symptoms of nervous and physical exhaustion.

In *hypermetropia* the headache is usually about the eyes and the frontal region; in *astigmatism* frontal and occipital. Headache from eye-strain may occur daily with exacerbations. In school children the pain usually comes on with greater severity during the afternoon. In the early part of the week the pain is not so severe, but increases until during the latter days it culminates in a sick headache. One-sided headache is frequent in cases of unequal refraction. *Supra-orbital* neuralgia is a frequent symptom in the spasm of accommodation. Pain in the top of the head is rarely the result of eye-strain, though it may occur in conjunction with frontal and occipital pains. Constant pain in the back of the head and neck is frequently accompanied by lameness of the muscles and tender places along the cervical vertebræ, and is a symptom of astigmatism. *Vertigo* is a frequent symptom of oblique astigmatism as well as hyperphoria. Tenderness of the ocular muscles is almost a constant symptom of hyperphoria.

General muscular asthenopia occurs frequently with greatest severity in *astigmatism* of low degree.

Cases of epilepsy and chorea have been reported as cured by the correction of errors of refraction.

The general health, digestion, assimilation and excretion are modified by eye-strain, and anæmia, intestinal toxæmia, renal insufficiency, hepatic, intestinal, and gastric catarrh are among the results of reflex irritation from defective refraction.

The *local results of eye-strain* to the exterior of the eye are inflammation and swelling of the margin of the lids, chronic:

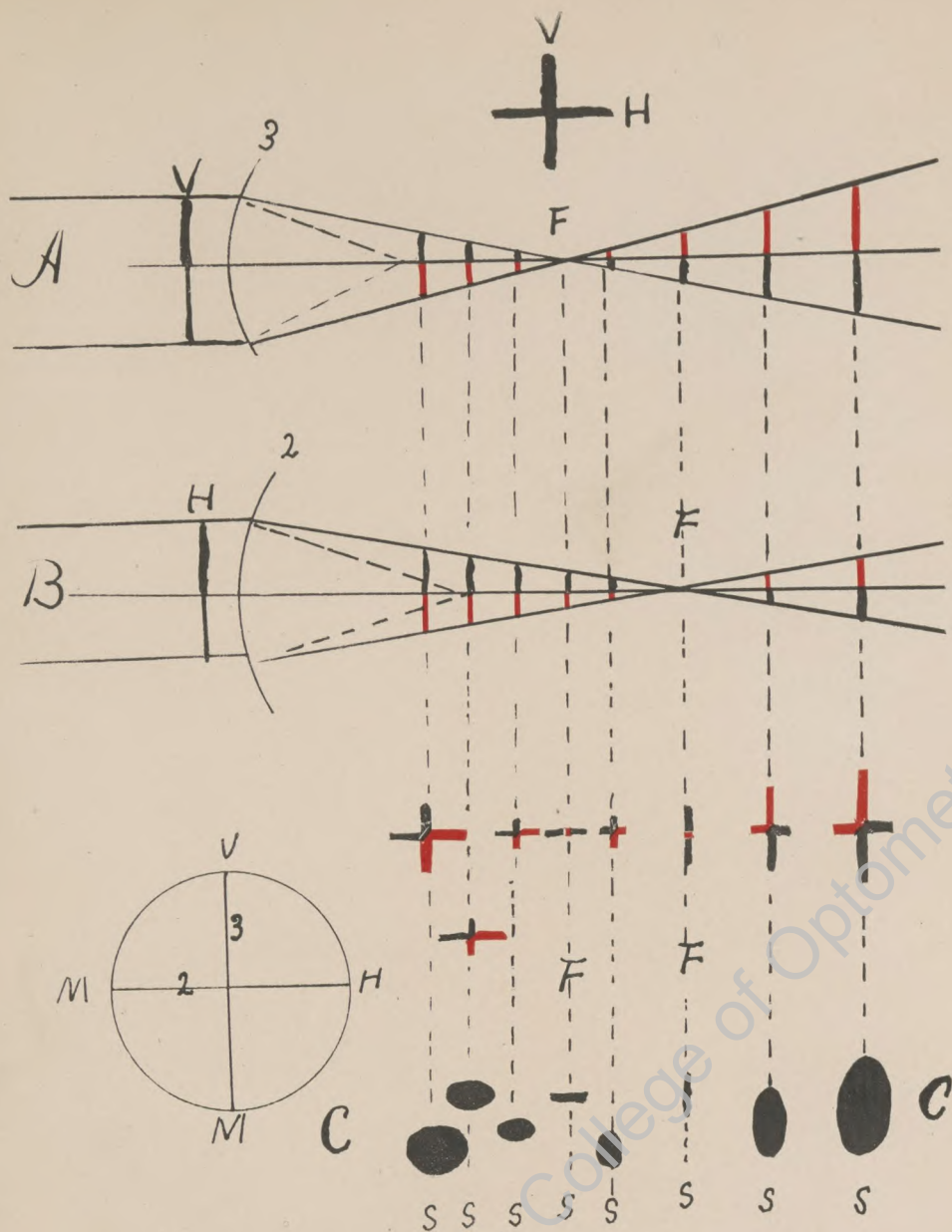


PLATE XXX.

(After Landolt.)

- V. H. A figure of a cross thrown upon a screen.
- V. M. H. M. The sphero-cylindrical lens having a refracting power of 2d. at H. M. and 3d. at V. M.
- A. The refraction of lines passing through the vertical meridian.
- B. The refraction of lines passing through the horizontal meridian.
- F. and F. The focal points of the H. and V. meridians.
- S. S. Screens in different positions.
- C. The appearance of the cross when thrown upon the screen.
- D. The shapes of a beam of light when thrown upon a screen.
- S. S. S., etc.

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blepharitis marginalis, loss of the lashes, and recurrent styas. To the conjunctiva, papillary conjunctivitis, chronic catarrhal conjunctivitis, episcleritis. To the eye itself, hyperæmia of the iris, ciliary body, choroid and retina, mal-nutrition of the lens which may result in cataract.

Eye-strain has its influence in determining the localization of disease in the eye during a general infection, as in rheumatism, gout, tuberculosis, and syphilis; chronic irritation of the ciliary body causing over-secretion and lowered drainage, resulting in glaucoma or chronic irido-cyclitis, and in eruptive diseases causing progressive malignant myopia.

It does not seem to me that it is going too far when we say that intestinal catarrh may be the indirect result, in a given case of an uncorrected astigmatism; or that an uncorrected error may lead to disease of the choroid coat and result in a progressive myopia, detachment of the retina, and cataract.

The careful study and correction of errors of refraction and accommodation in early childhood prepares the patient to enter into the preparation for his life work with one less transmitted or incidental handicap. We are able to modify the results of congenital and acquired defects in most cases and place the child, so far as the eyes are concerned, upon a better footing, and make it possible for him to do the work required of an average child under favorable conditions without endangering the eyes or impairing the general health. We can also determine whether the child should do any work requiring close vision, and whether he should be taken from school and all close work, and put under favorable hygienic surroundings.

There is hardly a function of the body which may not be directly or indirectly disturbed by an error of .50, .25, or even .13, providing the conditions are favorable. A patient may, for a time, under the stimulus of change of environment or occupation, the use of sedatives, tonics, or stimulants, be able to ward off the results of the astigmatism, but sooner or later the effects from the strain are felt and seen.

Simple myopic astigmatism is not a frequent error, but is a very troublesome one, and patients are annoyed by the use of their glasses until the accommodation is trained to accept the correction. The meridian of error, as a rule, is found at 90° , and is partially masked by the action of the ciliary and recti muscles and by nipping the lids. During the examination you must be constantly watchful lest they mask the error completely by converting the lid apertures into stenopaic slits, and in that way exclude the light from the meridian of error and secure a clear image.*

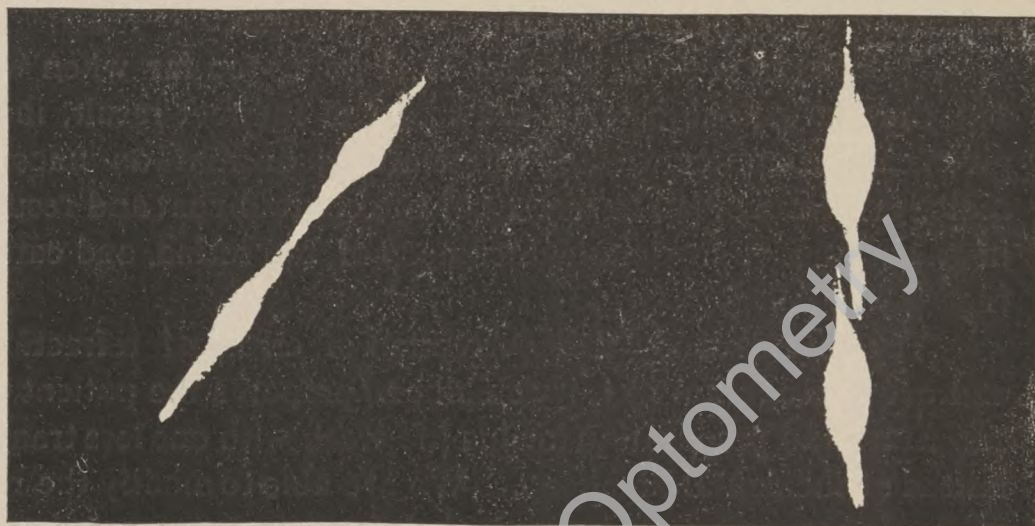


FIG. 165.

Dr. H., aged thirty-two years, has suffered from frontal and occipital headaches from childhood. He desires us to test his visual acuity and examine him for an error of refraction. $V = \frac{2}{4} \frac{0}{0}$ with lids almost closed, with eyes wide open $= \frac{2}{10} \frac{0}{0}$ —9.d. ax. 180° ; eyes opened widely gives $\frac{2}{2} \frac{0}{0}$ vision. Examination with the ophthalmometer shows that the greatest error is at 180° . The ophthalmoscope examination also shows that error is hyperopic. By fogging the vision with a —6.sph. we find that upon removing the fogging glass the vision

* A simple hyperopic astigmatism may, by the aid of the muscles of accommodation, be converted into a manifest myopic astigmatism. This case will illustrate.

is low. Upon fogging with a +3. the vision is improved. We now conclude that we have hyperopic astigmatism, and use atropia sulph., one per cent solution, for forty-eight hours. The result of our second examination is, $V = \frac{1}{2} \frac{0}{0}$, with +9.d. cy. ax. 90° vision = $\frac{2}{2} \frac{0}{0}$. Our patient will experience great difficulty in using his full correction on account of his habit of over-accommodation. He has been accommodating = 9.d. and focusing his horizontal meridian upon the retina, making his vertical meridian myopic, the rays passing through the ver-

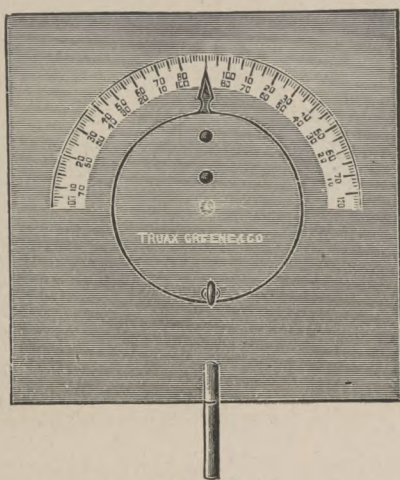


FIG. 166.

tical meridian were shut off by converting the lids into a stenopaeic slit, in that way securing fair vision.

Mrs. L. K., aged twenty-five years, has been during the past three years, since the birth of her child, subject to severe occipital headaches and gastric storms. She is almost always constipated or obstipated. She cannot read or sew, and is subject to attacks of vertigo. The facial symptom of eye-strain to which I desire to call your attention is the very heavy development of the orbicularis muscle and the nipping of the lids while inspecting objects closely. The eyes are almost closed, the upper and lower lids allowing but a small aper-

ture. When the patient's attention is first called to the test her vision = $\frac{2}{2} \frac{0}{0}$ for a moment, and later $\frac{2}{4} \frac{0}{0}$ or $\frac{2}{6} \frac{0}{0}$; when you request her to open her eyes widely she reads $\frac{2}{8} \frac{0}{0}$ with difficulty. Place a stenopaic slit in front of the left eye and she reads $\frac{2}{3} \frac{0}{0}$ with ease. We hold a perforated card in front of the eye with the two perforations two inches apart and horizontal. She sees two points as elliptical spots, with the long radius vertical (Fig. 165). Then rotate the card until the spots are one above the other, and the elliptical spots are fused into a single line of light; now cut off the rays passing through the meridian of error with the stenopaic slit and the perforations are seen to be round. Professor Hotz

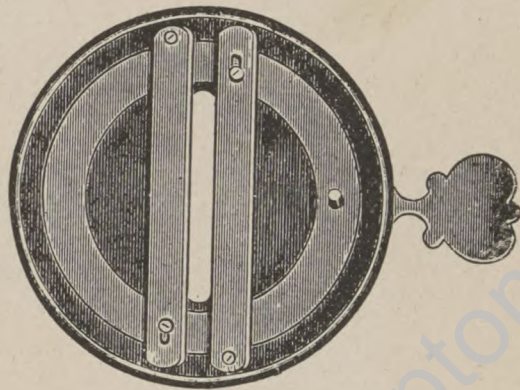


FIG. 167.
Gill's adjustable stenopaic slit.

has used the principle involved in the above experiment and constructed a very useful astigmometer (Fig. 166). You can use the stenopaic slit (Fig. 167) with your spherical lenses and approximately correct a simple astigmatism. In this case the clear line on the wheel is horizontal. That meridian must be correctly focused, so we place the stenopaic slit parallel to the meridian of error, which is vertical. We now place in front of the eye a $+.50$ sphere, the error seems to be increased. We now place $-.50$ sph. and find that it is shortened; -1 sph. shortens it; -2 sph. changes the direction of the ellipse, a $+.25$ corrects the error, and the patient is able to read $\frac{2}{3} \frac{0}{0}$. In order to place the patient's eyes at rest we will have atropine instilled for forty-eight hours and test under complete

paralysis of accommodation. We will experience no little difficulty in convincing this patient that the glasses we shall give her are suited to her eyes, for the orbicularis muscle will give trouble for some time.

In dealing with compound myopic or hyperopic astigmatism we have a more complex and difficult problem.

The test card and letters are frequently no aid in detecting the nature of the difficulty, and we are obliged to call to our aid, first, the ophthalmoscope, if we are expert enough to use it for refraction purposes; next, the *ophthalmometer* in some form, or the retinoscope. You will make your record of vis-

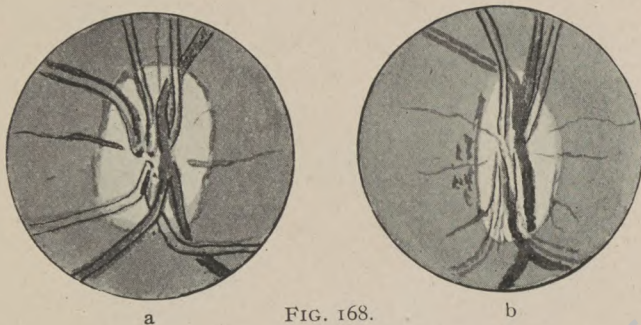


FIG. 168.

ual acuity, examine with the ophthalmoscope and oblique illumination, first, to determine the transparency of the media and to see if the retina is normal; next, to determine the size, shape and clearness of the disk (Fig. 168).

Master L., aged sixteen years, a school-boy, referred because he can not do his work as well as the average in his class, and because the school test of visual acuity shows him to be below normal. We find him to be in fairly good health, slow and contradictory in answering our questions regarding the test card. The margins of both the upper and lower lids are diseased—blepharitis marginalis. The ocular and tarsal conjunctivæ are both flushed, especially in the lower retro-

tarsal fold, and covered with follicular granulations, which are small, hard and bead-like in appearance. He avoids strong light, and can only look at the test card a short time without excessive lachrymation. $V = \frac{2}{8} \frac{0}{0}$ to $\frac{2}{1} \frac{0}{0}$. As a preliminary test we use the Wyeth homatropine disks, No. 338, and supplement this with adrenalin to relieve the photophobia. At the end of twenty minutes he reads $\frac{2}{2} \frac{0}{0}$ on the card, but cannot read the other letters. His vision is $\frac{2}{2} \frac{0}{0}$. With the oph-

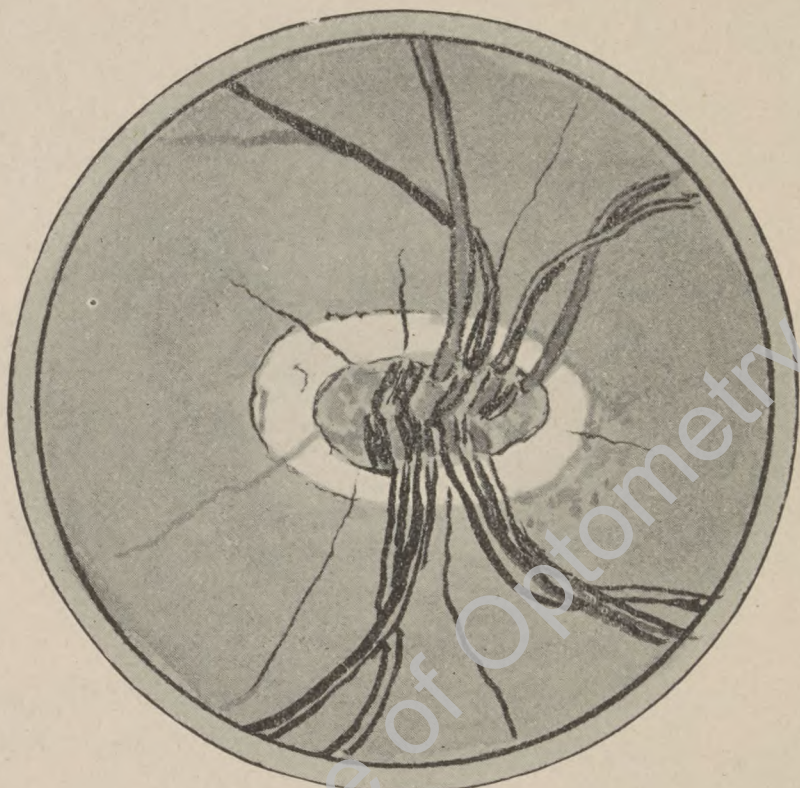


FIG. 169.

thalmoscope we find a small, oblong disk, with a deep physiological excavation (Fig. 169). The small disk indicates hyperopia, and the small, oblong disk compound hypermetropic astigmatism. We find that a +2. d. sphere brings out the small, horizontal blood vessels and that +4. d. clears up and broadens the vertical. This indicates that there is an error approximately of +2. sph., with a +2. cy. ax. 90°. With the retinoscope examination, +2.50 arrests the shadow in the vertical meridian, and +4.75 in the horizontal meridian. From

this test we determine that the error is +2.50 sph., with +2.25 cy. ax. 90°. This correction is placed in the trial frame and our patient reads $\frac{20}{20}$ —2., i. e. two letters are miscalled. We place a —0.25 in front of this correction, and the remaining letters are cleared. The correction of the fellow-eye is +2, with 2.75 ax. cy. 90°. Shall we give a sixteen-year-old boy in fair health a full correction for constant use? In this case, yes, for his vision was low enough to show that he did not accommodate enough to correct the hyperopia up to the lowest meridian of error. I shall allow him .25 off for his habitual accommodation and prescribe

R. +2.00=+2.25 cy. ax. 90°.
L. +1.75=+2.75 cy. ax. 90°.

Miss M., aged thirty-two, a seamstress, has been subject to frontal and occipital headaches, never severe, but sufficient to make her work irksome and painful. During the early part of each day she reads or sews with comfort, but by 10 A. M. she has sharp pains in and about her eyes. She assures me that she had no trouble until she had an attack of diphtheria about ten years ago. She has worn glasses, but has never been examined properly for them. Vision $\frac{20}{20}$ and the lines upon the wheel are uniformly clear. Ophthalmoscope shows fundus and media normal and clear. Atropine has been used for forty-eight hours. R. V. = $\frac{20}{80}$; L. V. = $\frac{20}{160}$. The spherical error, R., +1.; L., +1.50 was easily estimated, but the retinoscopic examination indicates an astigmatism. We now try and determine it, but find that one line after another is asserted to be clear, then the entire disk is blurred. We know now that we have not obtained complete paralysis, and that further use of the atropine must be required. We continue its use for twenty-four hours with the injunction that greater care be employed in using the drops. On the second visit we find that the vision is R., $\frac{20}{120}$; L., $\frac{20}{180}$. We now find that she accepts R., +1.25 sph., +50 cy., ax. 90; L., +2. sph., +1., cy. ax. 120.

I find it necessary to use homatropine in all cases of astigmatism, even up to fifty years of age, and even though the patient is not hyperopic. It is necessary to review cases of astigmatism frequently, once a year during early life, and once in from one to three years from eighteen to forty, and once a year from forty to fifty. During the period of adolescence the entire structure of the body undergoes more or less change. From forty to fifty astigmatism may appear or disappear, or become modified, both as to meridian and as to amount. When the eyes are refracted separately and the axis found to be oblique in one or both eyes, I find it expedient to go over the combined correction, both before and after the mydriasis has passed off, to see whether it is necessary to change the position of the axis in one or both eyes. I have frequently found it necessary to do so to relieve a troublesome asthenopia which follows the use of the lenses.

Dr. Savage is doing a good work in elucidating the errors which arise from faulty adjustment of the oblique muscles. I have considered that the investigation and experimental work had not yet passed through the test of experience, but I advise those of you who intend to pursue this work to read his treatise upon the subject.

Compound myopic astigmatism in a patient twenty years of age who has been wearing a correction (?) for imperfect vision.

Miss V. has worn department-store glasses for the past six months. She had been wearing glasses before that time, prescribed by a competent oculist. They were in a steel frame and somewhat scratched. She desired to have them set in a gold frame, but was assured this could not be done, though for a consideration he (the department-store expert) would furnish her with new ones "just as good" and frame them in gold. This was done and since that time she has been trying to work with her new correction. She complains

that during the past six months she has had constant headaches; before that time, during the use of Dr. S.'s correction, she had been free from eye-strain and headache. We find that she has vision of $\frac{20}{200}$, that she holds her work close to her eyes, and that she constantly rubs her lids. A —1.d. improves vision and brings out the XII to VI line clear and distinct. Atropine was used for forty-eight hours and her vision was found to be $\frac{20}{120}$ with eyes tested separately or together.

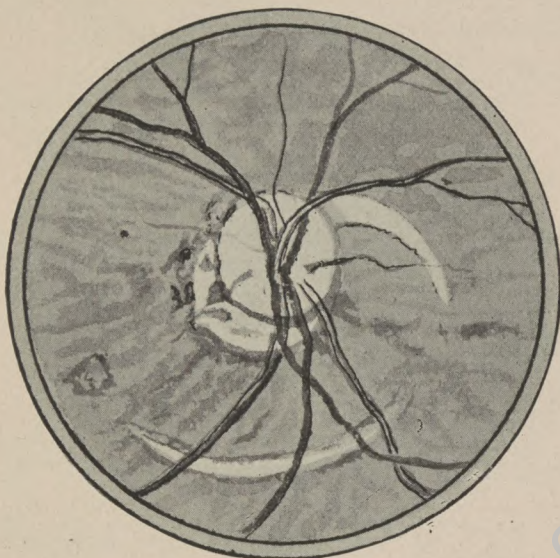


FIG. 170.

The disk is flushed and there are two areas of circumscribed choroiditis just at the margin of the disk in the right eye, and an advanced choroidal atrophic ring in the macula area of the left (Fig. 170.) Both conditions seem to be of recent origin. She has been wearing —3.d. sphere for constant use. The history card (Fig. 171) will give you the result of our test. You will see that she has been using her accommodation, —1.50d. sph., that the low astigmatism was not corrected and that everything points to the choroiditis as the result of eye-strain. Dr. S. kindly furnished his notes of the

case, and we find that his correction agrees with our findings, with the exception that her vision under the mydriatic was $\frac{2}{8} \frac{0}{0}$, and the myopia —.75 sph. —.25 cy. ax. 180. In this case it is of the utmost importance that our patient has complete rest of her eyes until the active choroiditis has subsided. I shall advise the continued use of the atropine, two drops once in four hours, and that she wear dark glasses out of doors and in

Name Miss V. Age 20 Sex Date 11-4 1890
 Resid. Referred by Dr. H.
 Occup. Sewing woman Resid.
 Diagnosis L } Javal { L ax
 R } Javal { R ax
 Hyperphoria, R. 0 I. 0 with -2 sph cy ° = 20
 Esophoria 0 In accommod. with -2 sph cy ° = 20
 Exophoria 5° In accommod. L = 1.50 with -1.50 sph -50 cy 180 ° = 20
 Abduct Adduct R = 1.50 with -1.50 sph -50 cy 180 ° = 20
 Sursumduction R. L. L = 1.50 s. -50 c. 180 Reads { L c.
 Ophthalmoscope Posterior staphyloma 0.2. R = 1.50 s. -50 c. 180 Reads { R c.
 Special Symptoms Headache 0 0 Asthenopia
 General History Good.
 Treatment Correction of error Sodium biborate sol.
Continued use of A.

YAWMAN & ERBE MFG. CO., ROCHESTER, N. Y. AND CHICAGO, ILL.

PATENTED JUNE 10, '91 DEC. 10, '94.

Fig. 171

brightly-lighted rooms; that she takes the wine of calisaya to improve the appetite and ten grains of sodium iodide after meals.

Mixed astigmatism is an error of comparatively infrequent occurrence. The visual acuity may not be so very low in those cases in which there has been no attempt at correction, and when both eyes are involved to about the same degree, for by the aid of both intrinsic and extrinsic muscles a large

part of the error can be masked. In this, as in other errors when one eye has greater visual acuity than its fellow (anisometropia) the less competent eye is not used, and its impression is suppressed. The patient has only monocular vision so far as the central field is concerned, and the disused eye may become, according to the condition of muscle imbalance, esotropic or squinting.

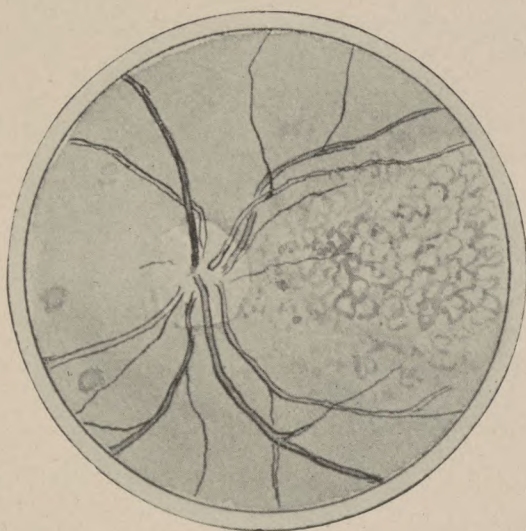


FIG. 172.

When one eye has been working alone on account of the low vision in the other eye, due to a correctible or partially correctible error of refraction, it is often difficult, and sometimes impossible, to secure binocular vision. I have found this to be true when the sizes of the two images were dissimilar owing to one eye being hyperopic and the other myopic in their total error, also, when there is mixed astigmatism in one eye and a simple or compound astigmatism in the other, this problem often has to be solved. There is no rule to aid you in determining the correction to be given. When vision is low in one eye and the image too small or too large, you

may find it expedient to place a plain glass in front of that eye. The personal equation of your patient, and experience, can be your only guide.

In examining for mixed astigmatism the shadow test is of great value both in obtaining the amount and the principal meridians of error. Before we used this method the Culbertson prisometer was about the only real aid in determining the refraction. The ophthalmoscope is of but little use, though it is suggestive. Frequently these cases have lower acuity in one eye than in the other, though the refraction is the same.

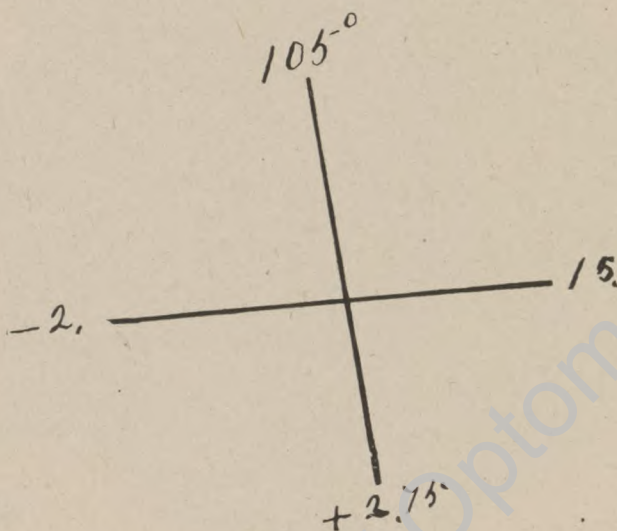


FIG. 173.

Master J., aged fourteen, always closes the right eye in reading and writing; has headaches, mostly frontal; is a good, though irregular, student in oral recitations, while in written examinations he is seldom up to the average. He says that he learns most of his lessons by talking them over with his class-mates, or by hearing others recite. Vision, O. D., $\frac{20}{40}$; O. S., $\frac{20}{180}$. Ophthalmoscope shows the fundus to be normal in the right eye, disk elongated vertically, being normal in its horizontal meridian, +50 cy. ax. 90. Left eye, posterior staphyloma and irregular blurred disk, clearing in the horizontal meridian with a +2, in the vertical -3.50 cy. Retinoscope, R., +37 cy. -75°; L., +2.50 cy. 15°. The left eye is difficult

to measure on account of the scissor-like swinging shadow. The test upon the card with retinoscopic findings, R., +37, cy. 75°, does not give $\frac{2}{3} 0$, but this can be explained by the large pupillary aperture, as no modification of this glass improves the vision above $\frac{2}{3} 0$, and the stenopaic disk gives $\frac{2}{3} 0$.

The findings in the right eye, +2.50 s. +4.75 cy. ax. 105° gives: Vision, $\frac{2}{4} 0$ and a +.25 added to that gives a vision of $\frac{2}{3} 0$, —2.

The error in cross cylinders would be counted by +2.75, ax. 105°, —2 cy. ax., 15°. (Fig. 173.)

Master K. attempted to study electrical engineering, and finds that the correction furnished him at the counter will not allow him to pursue his studies. During his grade and high school work he was aided by his sister, and was able to stand fairly well in his classes; but now that he is deprived of her help he finds that he is unable to keep up in his class work. Vision without glasses = $\frac{8}{2} 0$, and with +4, $\frac{2}{2} 0$; reads, 50 at eight inches. He can not see well after nightfall.

The Javal ophthalmometer gives an irregular corneal astigmatism of 9.d., the principal meridians at 90 and 180. With the shadow test we obtain —2 at 90° and 8.50 at 180°. Owing to the corneal irregularity the retinoscope does not give the most satisfactory results, but by using the formula as a guide we find the Culbertson prisoptometer a great aid, for the aperture is small and the revolving targets clearly made out. With this we find —3. at 90 +9.50 at 180°.

The findings from this examination gave a vision of $\frac{2}{4} 0$ in the right eye and $\frac{2}{4} 0$ — in the left eye, through the stenopaic disk.

Note—After the cycloplegia wore off he was able to read $\frac{2}{3} 0$, and uses his eyes with comparative comfort.

A case of afternoon headache.

Mr. H., aged 32, a bookkeeper, had suffered from afternoon headaches for several years. During his school days

they were not constant, and during vacation did not occur with any particular frequency or regularity; later in life, especially since his confinement at the desk, he has hardly been free from them for a day at a time, except during vacations or while under treatment, using caffein, bromides, or some of the coal-tar products. About two years ago he came under our care, and his history card illustrates the conditions found.

Name Mr. H. Age 32 Sex Date 7-14 1899

Resid. Referred by

Occup. Book-keeper Resid.

Diagnosis L. } Javal { L. ax.

..... R. } R. ax.

Hyperphoria, R. 0 L. 0 L. = $\frac{20}{80}$ with +1 sph. cy. ° = $\frac{20}{30}$

Esophoria 4° In accommod. R. = $\frac{20}{80}$ with +1.50 sph. cy. ° = $\frac{20}{30}$

Exophoria In accommod. L. = $\frac{20}{120}$ with +1 sph. +1.75 cy. 80 ° = $\frac{20}{20}$

Abduct. Adduct. R. = $\frac{20}{120}$ with +1.25 sph. +1.75 cy. 100 ° = $\frac{20}{20}$

Sursumduction R. L. L. +1.75 s. +1.75 c. 80 Reads { L. s. c.

..... R. +1 s. +1.75 c. 110 { R. s. c.

Ophthalmoscope Normal.

Special Symptoms Headache - frontal and cervical.

General History Fair

Treatment To wear full correction as soon as possible.

VISION WITH VISION WITHOUT ATROPINE.

DISC. HOMATROPINE.

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Fig. 174

He now reports that he can work from eight to sixteen hours a day without eye-strain, and that he has had but two attacks of headache in the past two years. (See history card, Fig. 174.)

A case of headache, eye pain, indigestion, and chronic constipation relieved by correcting glasses.

Mrs. B., aged thirty-five years, a housekeeper, has from early childhood suffered from severe headaches, occurring

once in one or two weeks, and almost constant pain through the forehead and at the back of the head and neck. She is subject to attacks of indigestion, chronic constipation, with flatulency and fleeting neuralgic pains. She is light in weight and anæmic. For a time almost any treatment directed toward the relief of these troubles would be of benefit. She says that the use of her eyes at close work, attending church or places of entertainment, a shopping tour, or any unusual use of the eyes will increase the pain and precipitate an attack of migrain. She also asserts that her vision is good, and that she can see as well as any one. We find, on testing, that she reads $\frac{20}{40}$ with the right eye and $\frac{20}{40} - 1$ with the left eye, and that, upon looking at the astigmatic card, first one line then another comes out clear and black, while the remainder of the card is blurred. We find that a weak plus or minus glass does not improve her vision, while a $+ .50$ cy. ax. 90° clears the wheel and improves the appearance of the test letters. We desire, however, to accurately correct the astigmatism and also determine whether there is any latent error. The ophthalmometer indicates that there is an error at 180° of $.75d$. The rule is that in hyperopic astigmatism the error is at 180 , and that the cylinder should be placed at 90 . Homatropine disks are now placed. The patient is examined one hour later. We now find the vision R. $\frac{20}{60}$, L. $\frac{20}{60}$, and that the IX to III line is clearly marked. The right eye is tested first, the left eye being covered, a $+25$ cy. clears the card somewhat, but the vertical XII to VI line is still indistinct. A $+ .50$ cy. is now placed in the frame, the XII to VI line is still indistinct, and a $+1$ cy. ax. 90° is substituted, when the vertical line becomes clear and the horizontal line is slightly blurred. We now know that the horizontal meridian has been over-corrected, and we hold a $-.25$ ax. 90 cylinder in front of the eye at axis 90° to neutralize the over-correction, when the entire field comes out clearly marked. We know now that the error is $+ .75$ cy. ax. 90° . The patient is now able to read $\frac{20}{20}$ with the corrected eye. The left eye is then

tested in the same way, and the trial glass, a $+1$ cy. ax. 90° , is found to clear the wheel. Vision $= \frac{2}{20} - 2$ is obtained; that is, two letters are not clearly made out. We again try to clear the letters, and a $-.13$ d. added at 90° clears the letters and the correction will be $+.87$ ax. cy. 90° .

In correcting an astigmatism of low degree you must take infinite pains to secure a perfect correction, for upon such care will your success as a refractionist depend. You will always be obliged to educate your patient to observe closely and tell you the result of his observations. Patience and tact are required to obtain good results.

Your patients will frequently inquire whether they cannot, after a time, lay aside their glasses. They may do so under the following circumstances: Hyperopes of low degree may lay aside their glasses for distance when they are no longer comfortable, or when the asthenopia for which they were prescribed is no longer troublesome. An error of one diopter or less in a perfectly healthy youth should cause no inconvenience in ordinary out-of-door life unless the eyes are imperfect in their function. *The strength of the plus spheres should be the strongest glass which, under favorable conditions, will allow of maximum vision,* and the glass should be changed to meet the requirements of the case. The strength of the concave spherical should be *the weakest glass allowing the clearest vision.*

A physiological myopia may not require correction if it be equal to one diopter or less unless the patient requires better vision. Myopia due to disease, or in which there is disease of the eye, should be corrected, and all close work enjoined until the active stage is past and the stage of repair is well advanced.

Astigmatism, whether simple, compound or mixed, should be fully corrected and the correcting glass worn constantly. In compound hyperopic astigmatism you may find it necessary to modify the spherical correction, but the patient should wear as strong a glass as can be worn with comfort. To adult

hyperopes, as a rule, I give the total correction found under atropine, less 0.25.d.; in youths all of the manifest error and half of the latent, the glasses to be increased in strength as soon as the accommodation will allow. When there is chronic asthenopia the final correction should not be given until all the spasm of accommodation that is possible has been relieved.

The treatment of hyperopia of high degree causing constant or periodic squint requires the use of a cycloplegic for weeks and months and the use of the full correction. It is

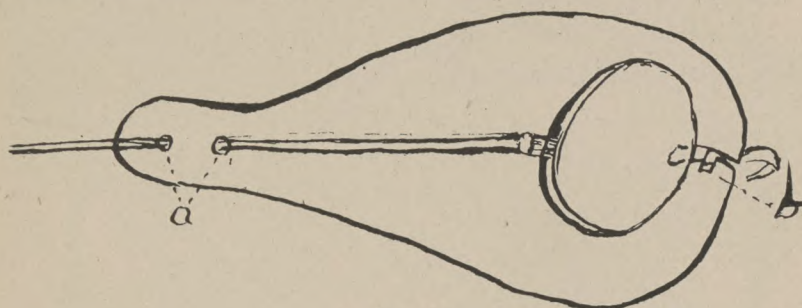


FIG. 175.
Cole's shield, made of black celluloid.
a. Holes for bow. b. Slit for bridge.

found to be very comfortable for the patient to have the correction ground in London smoke tint No. 3.

In addition to this, the cover shield (Fig. 175) should be worn over the eye that is habitually used for fixing. This will force the fellow, or disused, eye to exert its best efforts in seeing and to bring the recti muscles into greater activity. The cover should be worn from two to six hours a day, according to the age of the patient. The visual acuity of the squinting eye to be measured once in four weeks. Young children should be required to use the cover two or three hours daily, and, if the vision is very low, they should be kept indoors until vision is improved enough to keep them out of danger from falls or other injury. I believe that most of my early failures with this class of cases were due to the use of an im-

proper cover. The one I now use is made of celluloid, and can be adjusted to the frame, and it does not allow of any use of the covered eye. Later in the stage of treatment an aperture can be made in it to allow of vision on the nasal side of the field of fixation.

May X., aged seven years, is under treatment for periodic squint. R., $\frac{20}{40}$; L. $\frac{20}{80}$, with a +8.d. and +9.d. in each eye respectively. The right eye was covered with a shield, left eye fixing. This patient four months ago had a vision of $\frac{20}{40}$ in the right eye and $\frac{20}{180}$ in the left eye. The squint was constant then and now it only appears under excitement. The visual acuity of the left eye is fifty per cent.

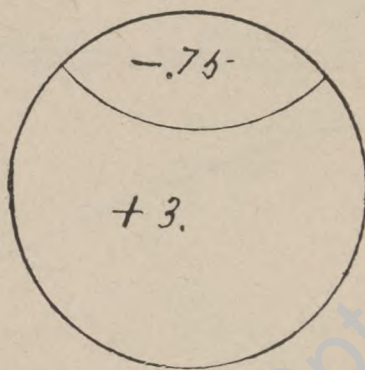


FIG. 176

better than it was at the beginning of the treatment. In another patient under treatment the vision in the disused eye has improved from $\frac{20}{200}$ to $\frac{20}{40}$ +. When the low vision is due to atrophy of the optic nerve or disease of the retina it is not expected that education will improve the vision of the eye or its seeing power. It will only improve motility of its muscles.

A *presbyope* with normal refraction requires only such aid as will enable him to see clearly the reading, writing or work at hand. It follows then that there can be no stated distance at which the test is made.

The use of bifocal lenses.

Mr. L., a book-keeper, aged fifty-four. A part of each day he is transferring from one book to another. In doing this one book is from twenty to thirty inches distant and the other is from ten to fourteen inches. He requires for the small figures at the nearest point a +3., but cannot see clearly at twenty to thirty inches. I have been able to overcome the difficulty by adding to the upper part of the lens a

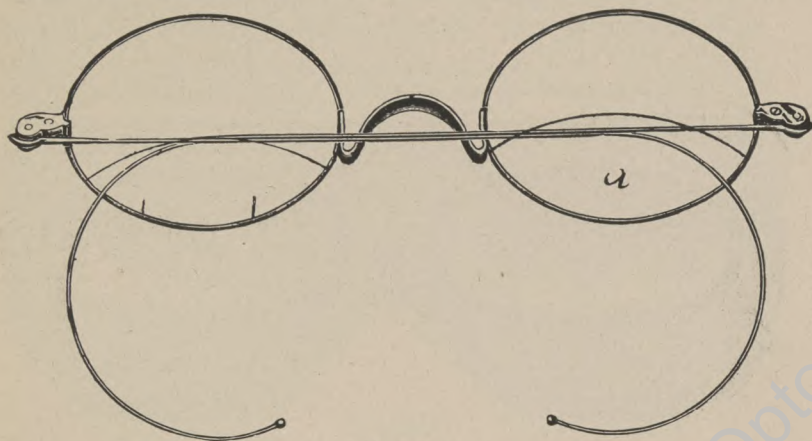


FIG. 177.

- | | |
|-------------------|--------------------|
| a. Large scale. | } For general use. |
| bb. Small scale. | |
| c. Reading scale. | |

scale —75 (Fig. 176). With this cemented bifocal he is able to work with accuracy and without discomfort. The bifocal lenses are a great convenience in all cases of error. They not only make it possible for one set of lenses to do the work of two, but do it with less time and nervous energy. In myopia the scales can be cemented to the upper or lower segment of the lens as is required. Presbyopia coming on in hyperopic or astigmatic patients necessitates the use of two pairs of glasses, one for distance and the other for reading, or close work, or the combination of the two in one frame as bifocals (Fig. 177.)

Mr. T., aged forty-four, is wearing a correction for compound hyperopic astigmatism R., $+1.50$ with $+1.50$ cy. ax. 80; L., $+1.50$ s with $+1.50$ ax. cy. 110. He has gradually come to wear his full correction, so that although it is two years beyond the time when he should have used a correction for his presbyopia, he is only now feeling the need of aid. We find that he reads No. 1 Snellen at sixteen inches with $+1$, and I have advised him to have the $+1$ cemented to his glasses in the form of a scale. Patients frequently complain of annoyance from bifocals, but usually become accustomed

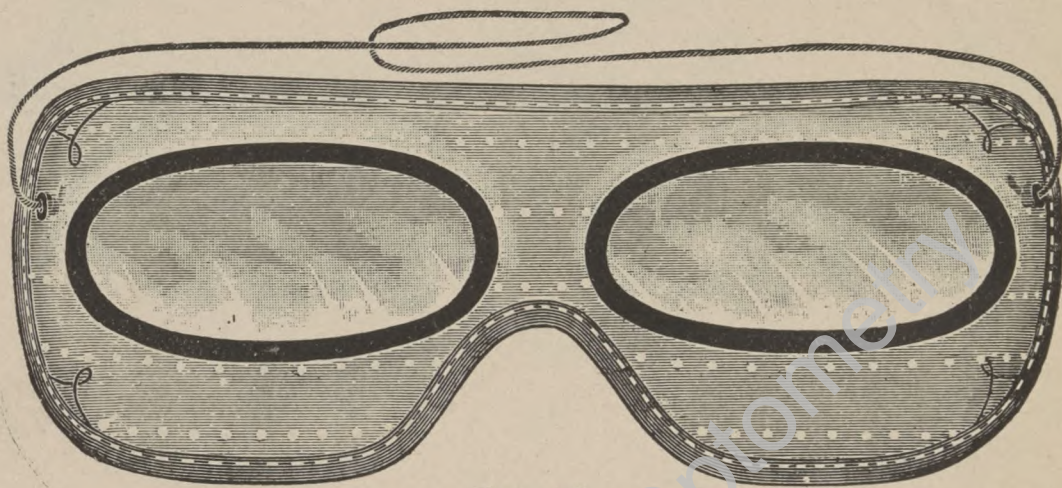


FIG. 178.

to them in a short time. When they are added, upon the first appearance of presbyopia, and changed as the increase of accommodative error demands, they can be worn throughout life for all purposes with comfort and safety. I have, however, come to the conclusion that it is unsafe in some cases to prescribe them, on account of the blurring of objects on the ground directly in front of the patient, which renders walking and going up and down stairs difficult and dangerous, especially to clumsy and heavy people. To the woman about the house, or the man in the shop or office, they are a great convenience.

Eye-protectors should be worn in shops where metal is being worked, as in grinding on emery wheels, or the turning

of wood or iron on lathes. Such precautions would prevent many serious accidents to people that work in such surroundings. (Fig. 178.)

Cataract glasses. About six to eight weeks after the extraction of a cataract, if the media are clear and no capsular or secondary opacity has appeared, a correcting glass can be adjusted. We have to take into account a certain degree of corneal astigmatism resulting from the operation, and whatever existed before the operation, and the fact that we have removed a lens from seven to twelve diopters in refractive power.

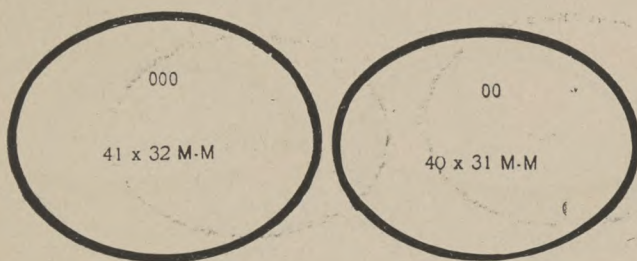


FIG. 179.

Doctor C., referred to in our lecture on cataract extraction, before the cataract developed wore a correction $+2s.$ $+1.75$ cy. ax. 90° . We now find that with $+10s.$ with $+2$ cy. ax. 180° he has $\frac{2}{4}$ vision. For reading he requires $+14s.$ $+2$ cy. ax. 180° ; he then reads No. 1 Snellen clearly.

This correction we will put into a reversible frame, enabling our patient by changing the glass in front of the eye to see either at a distance or near by. It will be three months before a permanent correction can be adjusted. By that time the corneal astigmatism resulting from the operation will have disappeared. I have also found it of use to add a $+2s.$ scale to the lower half of the distance correction to allow a clearer vision at seven or eight feet. Elderly patients walk with greater comfort when they see the ground clearly.

The practice of counter prescribing cannot be too strongly condemned. It is not an infrequent occurrence to have patients come into our clinics and find that they are wearing — spheres and cylinders when under proper examination they showed that they should wear + glasses. There are a few competent and well-trained refractionists who have taken up this branch of practice and do not attempt to treat diseases of the eye, and to them we are indebted for many of the perfected instruments used in refraction, but the man who travels throughout the country and fits glasses in our stores is not sufficiently trained to be safe. Such persons only know of the eye as an optical instrument and treat it as though it did not form a part of the person who used it in seeing. We are

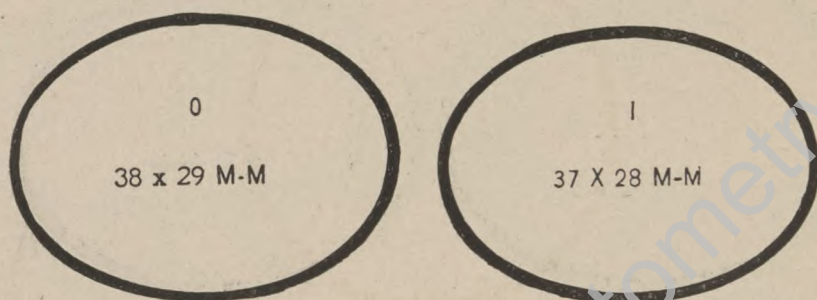


FIG. 180.

greatly indebted to the manufacturing optician for perfecting some of our most valued instruments, but the “*professors*” of refraction, the “*doctors*” of refraction, are a dangerous and usually an ignorant class, to whom people should not be referred by a physician any more than he should refer them to a druggist for treatment. To illustrate this point I will read you my notes of an interesting case and present a drawing made from the left eye of the patient to enforce my argument (Fig. 172).

Miss X., aged forty years, with an unusually good family and personal history, about six years ago began to suffer from general nervous and physical exhaustion, and about three years ago first noticed that her vision was impaired and that she could not see to read or write without discomfort. She

was at that time examined by a competent oculist and dark glasses prescribed, with some advice as to her general health. The examination was briefly and hurriedly made at that time. She was to make a revisit in a few days which, through unavoidable circumstances, was prevented. Our patient returned to her home when she was, some months later, advised by her physician to consult a so-called doctor of refraction, who advised her to discard the dark glasses and after a time she was able to do so, but his attempts to relieve her asthenopia were futile. He tried prisms, fogging glasses, etc. He then told her she had a muscle trouble and that she must

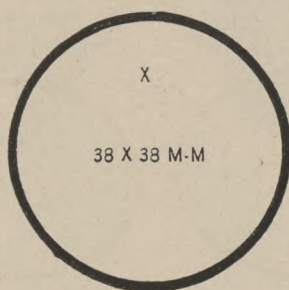


FIG. 181.

use prisms for its correction, which were attempted and discarded. She was then referred to me by her physician, and I found that she had an extensive choroiditis, the central areas of which lay beneath the region of the macula and were passing into the second stage, while the disease seemed to be active at the periphery and gradually extending. The vision was $\frac{20}{40}$, with a $+ 50$ cy. $\frac{20}{30}$, the retina being but slightly disturbed by the choroidal disease. There was no scotoma, though the vision was slightly lowered over the diseased area. The retinal appearance, personal and present history, point to disturbed elimination by the kidneys, though the urine showed no evidence of organic disease. She did not have enough error of refraction or muscle imbalance to account for all of the distressing symptoms presented. Had this patient

been able to return to the oculist who first saw her, or had she fallen into the hands of another competent man, she would have been saved much suffering and the danger which threatens her field of vision.

This is only one of the numerous cases which come to us illustrating the danger, not only to the general health, but of ocular disease, which may go undetected until it is too late to remedy the condition. Glaucoma, chronic disease of the choroid and ciliary body, acute neuritis and the early symp-

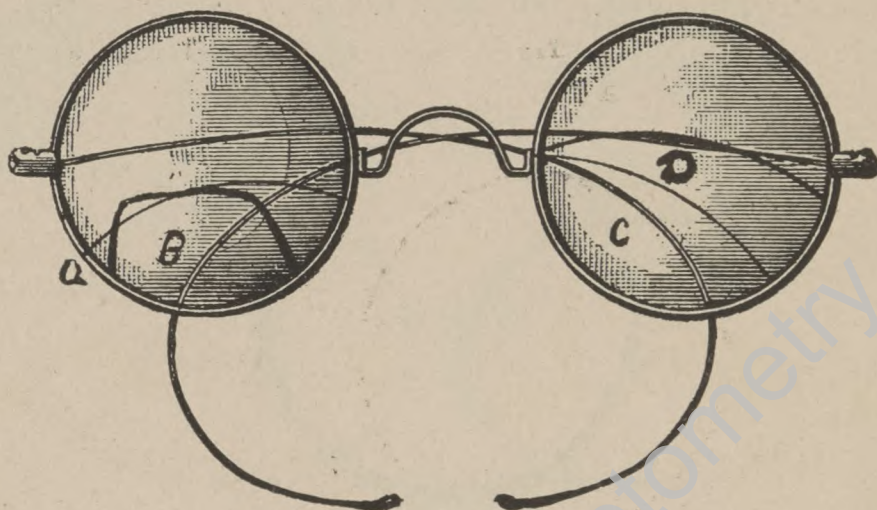


FIG. 182.

- a. b. c. Small scales for reading, book-keeping and other work requiring a small field.
- d. Large scale for dentists, musicians, painters and others requiring a large field.

toms of brain tumor and spinal and cerebral disease are the ones most frequently overlooked. There are competent men in our profession devoting themselves to the practice of ophthalmology in every large and small city for those who can afford to consult them, and free clinics for those who are not able to bear the expense of a private consultation, so that the general practitioner has no excuse for referring cases to a traveling or local optician for examination and treatment.

The fitting and adjustment of the frames must not be left to chance or the judgment of the optician. The size

of the lens is of great importance to the working patient. The lens should be as large as the patient can wear without disfigurement. The size of the face and the purpose for which the glasses are worn must decide you in your selection. A glass 37x28 mm. (Fig. 179) or 38x29 mm. (o) will be large enough for a child. For adults 38x29 mm. (o), or 40x31 mm. (oo). (Fig. 180.) Adults with large features will be able to wear a oo or ooo lens. Bi-focals should be oo or ooo in size to allow the use of a good-sized scale for close work. For dentists, book-keepers, artists, and others requiring a large up-and-down range I frequently prescribe 38x38 or a 40x40 mm. (Fig. 181), with or without the scale, as the patient requires.

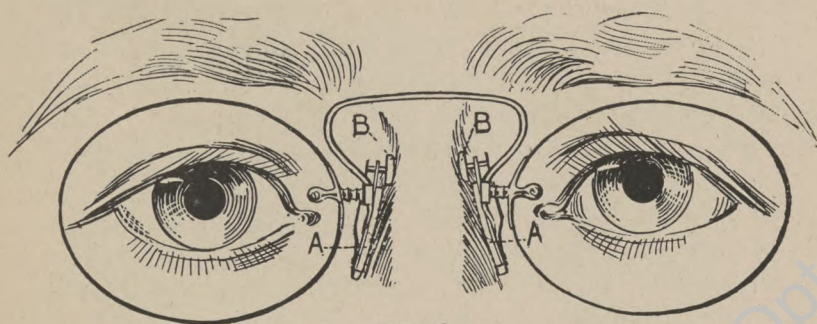


FIG. 183.

(Fig. 182). The center of the lens should be in the visual line in orthophoria. In order to secure this, and yet place the lenses in their proper position (Fig. 183), it may be necessary in some cases to decenter the lenses up or down, as the requirements of the case may demand. The question of decentering in heterophoria has been discussed under that heading. The frame should fit the face, the nose-bridge at proper angle and height, so that it does not cut the nose or allow the lashes to touch. Sometimes I find it necessary to have the ends of the longest lashes cut off to allow the lens to be placed close enough; this only in persons who have very long lashes or very prominent eyes. Eye-glasses may be prescribed for patients who can wear them with comfort. I

seldom allow nervous patients to wear them; they cannot be perfectly adjusted, and unless the nose is well shaped for them they are unsteady, and much of the time out of position. (Fig. 183.) The complaint that the bows behind the ears on the riding frame irritates and causes pain is usually the result of ill-fitting frames. They should be bent and formed to the shape of the temple and ear; not allowed to ride upon the cartilage, but shaped to fit its junction with the head. Frames for constant use should not be closed for the night, but a convenient place selected where they may be placed without danger of being bent. With a little instruction the patient, if old enough, will be able to keep them in shape. The lenses should be cleaned with tissue paper or soft cotton, but never with silk. Patients should return to you to have their lenses inspected and to note that they have been properly made and adjusted, or, if repaired, that the lenses are properly placed. I have known patients to consult another oculist on account of an asthenopia not relieved with glasses. In one case I found a cylinder which was not ground along the line of its axis, the center of the lens was plain, and the nasal and temporal side curved as they should be. Knowing the skill and care of the physician first consulted I inspected the lens and found the defect and returned the patient to him with a note calling his attention to the defective lens.

A mother and daughter exchanged glasses without knowing it and suffered a return of their asthenopic symptoms. They came to me greatly alarmed at the return of their troubles. It required but a moment to consult my records and adjust matters. Replacing broken lenses and repairing old frames frequently leads to annoyances of this kind.

For office people and indoor workers I frequently prescribe their correction in a tinted London smoke for use on their vacations or outings until the eyes become accustomed to the out-door light. Occasionally patients will return to you saying that their glasses, which are usually comfortable and afford them relief, become unbearable, and that they are

miserable with and without them on account of the blurring of vision, pain and strain. You will usually find that your patient is suffering from a muscular asthenopia due to nasal irritation, indigestion, constipation, or intestinal fermentation, and that the correction of these conditions will be followed by relief. I have found it a good practice to have my patients provide themselves with eye cups, and at night before retiring use a solution of soda biborate or common salt as an eye bath. Another good prescription is:

R.	Aq. ext. hamamelis.	℥ij
	Ether sulph.	℥ii

M.
 Sig. Bathe outside of the
 closed lids three or four
 times daily.

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